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FLOOD INSURANCE STUDY

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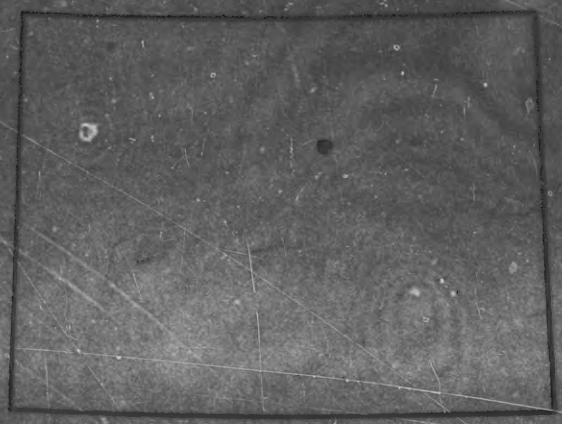

CITY AND COUNTY OF DENVER, COLORADO

VOLUME 1 OF 2

APRIL 15, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 080046

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City and County of Denver, Colorado, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Gingery Associates, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-4549. This study was completed in June 1981.

Revised hydraulic analyses for Clear Creek, Bear Creek, and Weir Gulch were performed by Dames & Moore for FEMA under Contract No. C-0542.

1.3 Coordination

Streams requiring detailed and approximate study were identified at a meeting attended by representatives of the study contractor, FEMA, the Colorado Water Conservation Board, the Urban Drainage and Flood Control District, and officials of the City and County of Denver on June 1, 1977. During the course of work done by the study contractor, hydrologic and other flood information was coordinated with FEMA, the U.S. Army Corps of Engineers, the Colorado Water Conservation Board, the Urban Drainage and Flood Control District, and the City and County of Denver.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City and County of Denver, Colorado. The area of study is shown on the Vicinity Map (Figure 1).

The City of Glendale and unincorporated areas of Arapahoe County located within Denver are not included in this study.

The limits of detailed and approximate studies were determined by FEMA with community and study contractor consultation at the meeting on June 1, 1977.

The flooding sources studied by detailed methods are shown in Table 1.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1986.

A hydrologic and hydraulic flood plain reanalysis has been planned for the South Platte River. Therefore, flooding determined for the South Platte River has been presented in this study as approximate until such time as a reanalysis can be incorporated into the study.

Due to current construction of channel improvements, flooding determined for Westerly Creek has been presented in this study as approximate.

Coon Creek, First Creek, and First Creek Tributary were originally studied in detail by the study contractor. The study contractor's analyses were based on basin development conditions existing along Coon Creek in 1978, and along First Creek and First Creek Tributary in 1977. Due to increased development within these stream basins, Coon Creek, First Creek, and First Creek Tributary analyses have been revised to reflect projected fully developed basin conditions. Flooding determined for these streams has been presented in this study as approximate until such time as development in these basins increases to the projected conditions.

Sloans Lake Basin was studied by the study contractor using approximate methods. An approximate analysis of Marston Lake North Drainage Basin was included in this study by Dames & Moore at the request of FEMA.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City and County of Denver.

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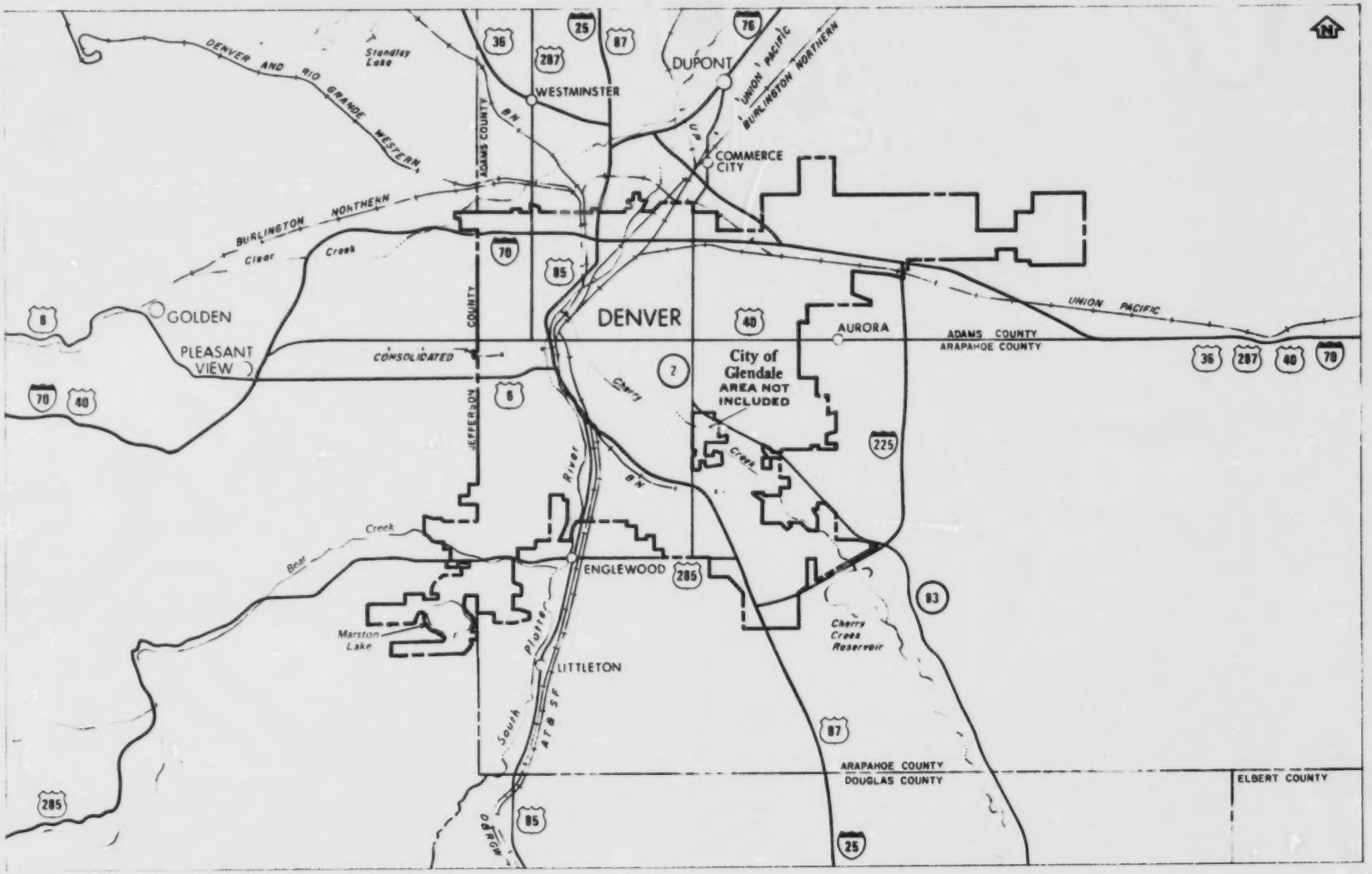

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

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Table 1. Flooding Sources Studied by Detailed Methods

Stream	Length and Location of Study Area
South Platte River	Approximately 10.0 miles, from the southern corporate limits at West Dartmouth Avenue to the northern corporate limits.
Clear Creek	Approximately 0.2 mile, at West 52nd Avenue in the northwest portion of the city.
Bear Creek	Approximately 3.0 miles, from the corporate limits at South Wadsworth Boulevard (State Highway 121) to the corporate limits at South Lowell Boulevard.
Cherry Creek	Approximately 9.3 miles, from Interstate Highway 225 to the confluence with the South Platte River.
Westerly Creek	Approximately 2.7 miles, from Kelly Road Dam (above 11th Avenue) to the confluence with Sand Creek.
Lakewood Gulch	Approximately 2.3 miles, from the corporate limits at Sheridan Boulevard (State Highway 95) to the confluence with the South Platte River.
Lakewood Gulch Overflow	From the divergence from Lakewood Gulch to the confluence with the South Platte River.
Dry Gulch (Lakewood Gulch Tributary)	Approximately 0.9 mile, from the corporate limits upstream of Sheridan Boulevard (State Highway 95) to the confluence with Lakewood Gulch.

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Table 1. Flooding Sources Studied by Detailed Methods (Cont'd)

Stream	Length and Location of Study Area
Harvard Gulch	Approximately 3.3 miles, from below South Colorado Boulevard (State Highway 2) to the confluence with the South Platte River.
Harvard Gulch Overflow	From South Downing Street (where overflows occur from Harvard Gulch) to the confluence with Harvard Gulch.
Dry Gulch (Harvard Gulch Tributary)	Approximately 0.3 mile, from below West Yale Avenue to the confluence with Harvard Gulch.
West Harvard Gulch	Approximately 1.0 mile, from South Federal Boulevard (State Highway 88) to the confluence with the South Platte River.
Goldsmith Gulch	Approximately 4.9 miles, from Belleview Avenue (State Highway 88) to the confluence with Cherry Creek.
Southmoor Park Tributary	Approximately 0.6 mile, from the detention pond above Hampden Avenue (State Highway 30) to the confluence with Goldsmith Gulch.
Sanderson Gulch	Approximately 3.4 miles, from the corporate limits at Sheridan Boulevard (State Highway 95) to the confluence with the South Platte River.
Weir Gulch	Approximately 3.5 miles, from the corporate limits at Sheridan Boulevard (State Highway 95) to the confluence with the South Platte River.

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Table 1. Flooding Sources Studied by Detailed Methods (Cont'd)

Stream	Length and Location of Study Area
First Avenue Tributary	Approximately 0.6 mile, from the corporate limits at Sheridan Boulevard (State Highway 95) to the confluence with Weir Gulch.
Dakota Avenue Tributary	Approximately 0.2 mile, from the corporate limits at Sheridan Boulevard (State Highway 95) to the confluence with Weir Gulch.
Sand Creek	Approximately 2.9 miles, in the northeast portion of the city through the Stapleton International Airport.
Coon Creek	Approximately 0.5 mile, in the southwestern portion of the city.
First Creek	Approximately 3.3 miles, downstream of Picadilly Road within the northeastern portion of the city.
First Creek Tributary	Approximately 1.3 miles, from the corporate limits at Picadilly Road to the confluence with First Creek.

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2.2 Community Description

The co-extensive City and County of Denver is situated on gently rolling land 40 miles east of the Continental Divide in north-central Colorado. The altitude is 5,280 feet on the steps of the State Capitol Building and is the reason for the title "Mile High City." Panoramic views of the towering ranges of the Rocky Mountains can be enjoyed from innumerable vantage points in Denver, and the vista sweeps from Pikes Peak, 75 miles southward, to Longs Peak, 65 miles northwest of the city. The population in the city is 490,000 according to the 1980 census; however, planners project a population of 614,000 by the year 2000.

Denver derived its name from James W. Denver, the Territorial Governor of Kansas at the time of the city's origin. In November 1858, a party of land claim "jumpers" appropriated the town site of St. Charles, located on the east bank of Cherry Creek, and established a new settlement named by them "Denver City." In April 1861, Denver City and its rival town, Auraria, consolidated under the name "Denver." When Congress authorized Colorado's entry into the Union on August 1, 1876, Denver was made the State Capital (Reference 1).

Denver is bordered by the incorporated Cities of Lakewood, Aurora, Wheatridge, Sheridan, Englewood, Cherry Hills Village, Littleton, Edgewater, Commerce City, Glendale, and Greenwood Village, and the incorporated Towns of Bow Mar, Lakeside, and Mountain View. Denver is also bordered by unincorporated areas of Adams, Jefferson, and Arapahoe Counties.

Denver has elevations ranging from nearly 5,200 feet to approximately 5,500 feet. With its location in the mid-latitudes in the interior of the North American continent, Denver experiences large temperature changes from summer to winter and rapid changes in weather due to storms travelling from west to east through the region. The mountains to the west effectively block atmospheric moisture originating in the Pacific Ocean and leave the area dependent on moisture from the Gulf of Mexico, which is not consistently brought to the region. Consequently, the region is dry with low amounts of precipitation that are quite variable through the year. Small amounts of water in the air are accompanied by a large percentage of sunshine and sizable temperature changes from day to night.

Large temperature changes are observed at Stapleton International Airport during the year, where the monthly average varies from 29.7°F in January to 72.9°F in July. The mean maximum varies from 43.4°F in January to 87.4°F in July, while the mean minimum varies from 16.0°F in January to 58.3°F in July, which is indicative of the extent of temperature change from day to night.

Average annual precipitation of 15.2 inches at Stapleton International Airport was determined from data taken over a 25-year period, while

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12.4 inches was observed downtown over a 23-year duration. Both stations show a distinct maximum in spring and summer, with a minimum in the winter season. Spring and summer bring much more frequent movement of air from the south and more solar radiation to produce convective showers. Average annual snowfall measurements are 66 inches at the airport and 56 inches in the central part of the city.

Average winds do not change much throughout the year. The prevailing direction is from the south in every month, and speeds vary from 8.2 miles per hour (mph) in late summer and early fall to 10.4 mph in April (Reference 1).

The soils in the Denver area are generally deep, well-drained, clayey soils that are neutral or mildly alkaline (Reference 2). There are significant sand and gravel deposits along the major streams in the city. These include deposits along the South Platte River, Bear Creek, and Clear Creek. The basins of Sand Creek and Cherry Creek contain fine sand, but little gravel (Reference 1).

The major stream in the Denver area is the South Platte River. It flows 380 miles from its headwaters at the Continental Divide in Park County to its confluence with the North Platte River at North Platte, Nebraska, where the drainage area is approximately 24,300 square miles. The drainage area of the South Platte River in Denver is approximately 3,800 square miles.

The major tributaries to the South Platte River in the Denver area are Cherry Creek (drainage area 410 square miles), Sand Creek (drainage area 189 square miles at Quebec Street), Clear Creek (drainage area 575 square miles), and Bear Creek (drainage area 261 square miles at the mouth).

In most cases, present-day conditions have reached or are approaching full urbanization for major drainage basins in the Denver area. The exceptions include Coon Creek, First Creek, and First Creek Tributary. Coon Creek is a smaller basin where a large amount of residential development is occurring. Clear Creek, Sand Creek, First Creek, and First Creek Tributary are larger basins with most of their development at the lower end of the basins near the confluence with the South Platte River. The Bear Creek flood plain has moderate residential development, with some open space and industrial commercial areas. The other major drainageways are fully urbanized in the Denver area and are bounded by residential development with the exception of the South Platte River and Cherry Creek, which also flow through commercial and industrial areas.

2.3 Principal Flood Problems

Past flooding along most of the streams in Denver has been well documented in several reports by the U.S. Army Corps of Engineers and the Urban Drainage and Flood Control District.

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Large floods have been reported on the South Platte River in 1844, 1864, 1867, 1876, 1894, 1921, 1933, 1942, 1965, and 1973. The largest and most damaging of these occurred June 16 and 17, 1965, when a discharge of 40,300 cubic feet per second (cfs) was computed at U.S. Geological Survey stream gage No. 06714000 near the 19th Street bridge in Denver. Flooding occurred throughout the South Platte River Basin with six persons drowned, two other deaths caused by flood-related activities, and estimated damages of $500 million, of which $300 million occurred in the Denver area (References 3-7).

Past floods on Clear Creek in the Denver area have been infrequent and usually not severe in the lower reaches. The major flooding has occurred upstream from Denver, including the City of Golden in 1888 (8,700 cfs) and 1956 (5,250 cfs), and Derby in 1965 (5,070 cfs) (Reference 8).

Flooding has occurred along Bear Creek in 1876, 1894, 1896, 1957, 1965, and 1969. The 1896 flood was the largest experienced, with 27 lives lost and severe property damage reported from the Town of Evergreen to the mouth. The discharge at the Town of Morrison gaging station was 8,600 cfs (Reference 9).

Prior to the construction of Cherry Creek Dam, major floods occurred on Cherry Creek in 1864, 1885, 1912, and 1933. Both the 1912 and 1933 floods were reported to have resulted in damages of approximately $1 million (Reference 10). Construction of Cherry Creek Dam was completed in 1950, and the dam is estimated to have prevented considerable damage during the flood of June 1965.

From 1942 to the present, there have been at least 14 years with major flooding events during which flooding of premises and impedance of traffic occurred. Flood-causing rainfall in these years produced overland inundation of homes and streets to depths of as much as 4.5 feet. Floodflows in this area (north of Lowry Air Force Base) for these storm events were in the range of 300 to 600 cfs.

From 1942 through the early 1960s, flooding problems were confined to areas downstream of Lowry Air Force Base. Since approximately 1965, rainfall flood events have begun to occur in the upper watershed as a direct result of the increasing density of development (Reference 11).

For Dry Gulch (Lakewood Gulch Tributary), there are no accurate records of flood history available; however, it is well known that there have been numerous instances of minor damage occurring at several locations along the stream (Reference 12).

Prior to 1965, Harvard Gulch experienced regular flooding due to summer thunderstorms. Considerable encroachment of the flood plain and channel occurred because of the lack of city zoning designed

to prevent such encroachment. The infringement on the channel was so complete that the defined channel ended approximately 0.5 mile from the South Platte River. Floodwater, searching out a route to the river, flowed down South Broadway, an important neighborhood business street (Reference 13). The Harvard Gulch Flood Control Project, completed in 1966, was designed for the 10-year flood and has alleviated these problems. The largest flood event since the completion of this project occurred on June 8, 1969. Three gages in this basin recorded between 1.2 inches and 2.6 inches of rainfall in a 1-hour period. The runoff hydrograph for this event was recorded at the gaging station near South Logan Street. The hydrograph peak was approximately 1,600 cfs, and this flow was confined within the drainage improvements (Reference 14).

For Goldsmith Gulch and Southmoor Park Tributary, little information is available on past flooding because development was sparse in these areas. Flooding indicative of what might be expected under present conditions occurred on May 5 and 6, 1973, when the capacities of the crossings at Dartmouth and Yale Avenues were exceeded by what was estimated to be a 5- to 10-year event (References 15 and 16).

Major floods have not occurred on Sanderson Gulch in the last 20 years and prior to that time there are no accurate records available (References 17 and 18).

For Weir Gulch, First Avenue Tributary, and Dakota Avenue Tributary, historical information on flooding is scarce. A few instances of flooding resulting in minor basement damage and some channel and bridge damage have been reported (References 19 and 20).

There were major floods on Sand Creek in 1896, 1912, 1917, 1921, 1933, 1938, 1948, 1957, and 1965. Because the basin was essentially undeveloped up to approximately 1940, flood damages are not well documented. The 1948 flood had a discharge at the mouth estimated at 10,500 cfs. Resulting damages throughout the basin were over $130,000. Near Stapleton International Airport the 1957 flood had a discharge estimated to be 25,000 cfs. Total damages throughout the basin were in excess of $330,000. The 1965 flood resulted in damages of $2,517,000 along Sand Creek. The discharge below Toll Gate Creek (located upstream in the City of Aurora) was 18,900 cfs (Reference 21).

Little definitive data on past flooding on First Creek and First Creek Tributary are available due to the sparse development in the area. Until recently, the First Creek and First Creek Tributary flood plains were entirely agricultural.

No specific information regarding historic flood magnitudes or extent of flooding and damages is available for Coon Creek, Lakewood Gulch, West Harvard Gulch, and Dry Gulch (Harvard Gulch Tributary).

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2.4 Flood Protection Measures

There are numerous dams, reservoirs, and channel improvements within the South Platte River Basin. Many of these flood protection measures affect flood peaks on the flooding sources that flow through Denver.

In addition to an active flood plain management program, the major flood protection measures, by basin, are listed below:

South Platte River

The Chatfield Dam and Lake along the South Platte River were authorized for construction by the 1950 Flood Control Act. The dam is located on the South Platte River just downstream from the mouth of Plum Creek, south of Denver. The reservoir has a storage capacity of 385,000 acre-feet, including 215,000 acre-feet for flood storage and 20,000 acre-feet for sediment control. The project provides a high degree of protection for metropolitan Denver and for extensive agricultural lands downstream from the city (Reference 4).

Clear Creek

There are 11 major reservoirs in the lower Clear Creek basin, 3 of which, Ralston Reservoir, Maple Grove Reservoir, and Leyden Lake, are on-stream and provide some residual flood control effects downstream from each site. None of these reservoirs has a specific flood control function.

Ralston Reservoir, located west of Denver and northwest of the City of Golden, was built in 1938 by the City and County of Denver. It receives water from Ralston and South Boulder Creeks and is used for municipal water supply. The outlet works deliver water to the Moffat Treatment Plant and have the capability of forcing the natural inflow back into Ralston Creek. Although Ralston Reservoir is not operated for flood control purposes, there is approximately 2,400 acre-feet of storage available between the primary spillway crest at elevation 6,046.0 feet and the top of the dam at elevation 6,060.0 feet. This storage provides incidental flood control.

Maple Grove Reservoir, which is located on Lena Gulch in the City of Lakewood, is owned by Consolidated Mutual Water Company and is used for municipal water-supply storage. The reservoir provides some attenuation of flood peaks. Approximately 452 acre-feet of storage are available between the crest of the inlet at elevation 5520.0 feet and the top of the fabridam at elevation 5531.0 feet.

Leyden Lake is an irrigation water-storage reservoir on Leyden Creek northwest of Denver. There are approximately 550 acre-feet of uncontrolled storage between the spillway crest at 5,612 feet and the crest of the dam at elevation 5,620 feet (References 22 and 23).

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Bear Creek

The completion of the Bear Creek Dam just downstream of the Town of Morrison has greatly affected the peak discharges of Bear Creek. Designed by the U.S. Army Corps of Engineers, the dam provides a flood control reservoir that intercepts flows from areas in the upper and middle parts of the basin. At the Bear Creek Reservoir, peak flows from the 100-year event have been reduced from 30,000 cfs to approximately 1,000 cfs through storage in the reservoir. There has been some straightening and enlargement of the channel downstream of the dam to reduce flooding in the lower, more developed areas of Bear Creek (References 9 and 24).

Cherry Creek

Cherry Creek Dam and Cherry Creek Reservoir were constructed by the U.S. Army Corps of Engineers, Omaha District, in 1953. The project, located immediately upstream of Denver, was constructed at a Federal cost of approximately $14.7 million and provides protection for Denver from flash floods on Cherry Creek. The reservoir has a flood-storage capacity of 79,960 acre-feet. During the June 1965 flood of record, the project prevented an estimated $130 million in flood damages. During the 1973 flood season, it prevented an additional $27 million in damages (Reference 4).

Retaining walls have been constructed along the Cherry Creek channel downstream of First Avenue to the confluence with the South Platte River. Portions of Cherry Creek, between First Avenue and the South Platte River, and in the vicinity of South Monaco Street Parkway, have been improved and recently rehabilitated to carry much of the 100-year floodflow within the channel banks. Earthen berms have been constructed south along Cherry Creek between South Holly Street and upstream of South Monaco Street Parkway, which have minimal effect on the 100- and 500-year flood.

Westerly Creek

The Kelly Road Dam on Westerly Creek was constructed by the U.S. Army Corps of Engineers in 1954 (Reference 4) to control storm runoff; however, the urban development upstream has lowered the protection level. A recent rehabilitation project has restored somewhat the structure's ability to attenuate flood peaks. Channel improvements are underway downstream of Kelly Road Dam. When completed, they will further reduce the flood hazard between 11th Avenue and Stapleton International Airport.

Coon Creek

The Coon Creek basin is undergoing rapid development, with more proposed for the future. The emphasis is on channel improvements that will confine the 100-year flood to the channel. Individual

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developers are constructing the channel improvements as new subdivisions are built adjacent to the existing channel.

Harvard Gulch, West Harvard Gulch, Dry Gulch (Harvard Gulch Tributary)

Several drainage improvement projects have been constructed in the Harvard and West Harvard Gulch basins over the last 15 years. The more extensive improvements were made on Harvard Gulch as part of the Harvard Gulch Flood Project, which was the result of a $2.3 million bond issue passed by Denver in 1964. This project included an underground box culvert from South Logan Street to the South Platte River where the channel had been obliterated by development. A grass-lined channel was designed through Logan Park; this channel also serves as an inlet to a detention pond in the park.

Above Logan Park, from South Ogden Street to South Downing Street, improvements included a second box culvert. This culvert connects with a high-velocity concrete channel from South Downing Street upstream to South Race Street. Above South Race Street, improvements were made to the existing grass-lined channels. The system will safely convey floodflows slightly less than what could be expected to result from a 10-year storm event.

In addition, since 1964, several storm sewer systems have been constructed in this basin. The most extensive system is along Dry Gulch (Harvard Gulch Tributary). There, the storm sewer serves to intercept nuisance flows that would otherwise flow through residential lots where this channel has been obliterated. The storm sewer is designed to convey the 10-year storm.

In the West Harvard Gulch basin, the main drainageway improvement is an underground conduit that extends from just above the Burlington Northern Railroad to South Zuni Street. The conduit handles West Harvard Gulch low flows, and an improved grass-lined channel above these culverts carries overflows during flood events. The West Harvard Gulch channel in this area will pass the 100-year flood with only minor overbank flooding (Reference 14).

Goldsmith Gulch and Southmoor Park Tributary

Development has encroached on the Goldsmith Gulch flood plain, particularly through Denver where various structural improvements have been made to provide a limited degree of conveyance for floodflows.

Structural improvements along the downstream portion of Goldsmith Gulch include a berm constructed along the east edge of South Monaco Street Parkway near the confluence with Cherry Creek, and regrading of the flood plain in the vicinity of Evans Avenue. Improvements along the upstream portion of Goldsmith Gulch include the construction

of the Eastman Avenue crossing of Goldsmith Gulch, and regrading within the flood plain at several locations throughout the reach.

Southmoor Park, a large, open area along Southmoor Park Tributary, serves as a detention pond that reduces flood magnitudes along the tributary and along Goldsmith Gulch (Reference 15). Additional improvements include the construction of the Eastman Avenue crossing of Southmoor Park Tributary.

Sanderson Gulch

At the upper end of the Sanderson Gulch drainage basin, in the City of Lakewood, there are two irrigation storage reservoirs that affect the discharges along Sanderson Gulch during the major flood events. They are Smith Reservoir and Kendrick Reservoir. There are also a series of small reservoirs, lakes, and detention ponds along Sanderson Gulch upstream of Denver that offer some flood protection.

On Sanderson Gulch, an improved grass-lined channel extends from the South Platte River to South Federal Boulevard (State Highway 88). Culverts were improved at South Lipan Street, West Arkansas Avenue, and South Zuni Street. Only minor improvements were completed from South Federal Boulevard (State Highway 88) to South Sheridan Boulevard (State Highway 95) consisting primarily of small drop structures.

Improvements were made to the Bit-O-Sea Reservoir located on Sanderson Gulch immediately upstream of South Sheridan Boulevard (State Highway 95) within the City of Lakewood. The earth embankment was raised and protected to increase storage, and the spillway was improved to increase capacity for discharge of the 100-year event.

Weir Gulch

In the upper part of the Weir Gulch drainage basin, there are three irrigation storage reservoirs that affect the floodflows on Weir Gulch: Main Reservoir, Smith Reservoir, and East Reservoir, located upstream of Denver, in the City of Lakewood. There are also two lakes along Weir Gulch, Kountze Lake (also located in Lakewood) and Barnum Lake, both of which store floodwaters and protect areas downstream from flooding.

Channel improvements along Weir Gulch have been constructed from West Alameda Avenue to the confluence with the South Platte River (References 25-29). Improvements include the regrading of Barnum Lake and the construction of an additional outlet culvert under West 6th Avenue (U.S. Highway 6), designed to reduce the extent of 100- and 500-year flooding below Barnum Lake.

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Sand Creek

Levees are located along Sand Creek in the vicinity of Havana Street; however, these levees have no effect on the 100- and 500-year floods.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analysis for Clear Creek was performed by the U.S. Army Corps of Engineers, Omaha District (Reference 23). Their analysis was based on fully developed basin conditions. Discharge records for the Clear Creek stream gages at Golden and Derby were analyzed using methods presented in Bulletin No. 17 published by the U.S. Water Resources Council (Reference 30). The results of these analyses were used to calibrate to the following runoff models: the Massachusetts Institute of Technology Catchment Model (MITCAT) (Reference 31), and the Environmental Protection Agency Storm Water Management Model (Reference 32). MITCAT was used to model the 400-square-mile mountainous area upstream from Golden; the Storm Water Management Model was used to model the lower 175-square-mile plains basin. Rainfall values used in the models were obtained from the Precipitation-Frequency Atlas of the Western United States, Volume II, Colorado, published by the National Oceanic and Atmospheric Administration in 1973 (Reference 33).

The hydrologic analysis for Bear Creek was performed by the U.S. Army Corps of Engineers, Omaha District (Reference 24). The Bear Creek Dam and Reservoir intercepts flows from 239 square miles of the total 261-square-mile drainage basin. The remaining square-mile drainage area below Bear Creek Dam still has the potential of generating damaging runoff flows during a cloudburst event over the lower basin. No applicable runoff records are available through this reach because of the recent construction of the dam. Therefore, discharges for the 22-square-mile drainage area below the dam were developed by using the U.S. Environmental Protection Agency's Storm Water Management Model (Reference 32) with modifications by the Missouri River Division of the U.S. Army Corps of Engineers. These discharges were computed assuming full basin development.

Peak discharges for Cherry Creek were previously determined as part of the July 1976 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Cherry Creek (Reference 10). Those discharges were computed using the U.S. Environmental Protection Agency Storm Water Management Model (Reference 32). The Cherry Creek basin was assumed to be fully developed.

Peak discharges for Lakewood Gulch and Lakewood Gulch Overflow were previously determined as part of the 1976 Urban Drainage and Flood Control District major drainageway planning report (Reference 34). Those discharges were computed using the Colorado Urban Hydrograph Procedure as outlined in the Urban Storm Drainage Criteria Manual (Reference 35). Split flows were calculated along Lakewood Gulch in the reach between Decatur Street and the South Platte River. The divergence of flows from Lakewood Gulch at Decatur Street is referred to in this study as Lakewood Gulch Overflow.

Peak discharges for Dry Gulch (Lakewood Gulch Tributary) were previously determined as part of the 1977 Urban Drainage and Flood Control District Flood Hazard Area Delineation report (Reference 12). The Colorado Urban Hydrograph Procedure (Reference 35) was used to compute the 10-, 50-, and 100-year events under fully developed basin conditions. The 500-year flood peak was obtained by extrapolation from the frequency-discharge curve.

Peak discharges along Harvard Gulch, Harvard Gulch Overflow, Dry Gulch (Harvard Gulch Tributary), and West Harvard Gulch were determined as part of the 1979 Urban Drainage and Flood Control District Flood Hazard Area Delineation report (Reference 14). Those discharges were computed using the Colorado Urban Hydrograph Procedure (Reference 35).

Split flows were calculated along Harvard Gulch between South Downing Street and South Logan Street. Due to the limited capacity of the box culvert between South Downing and South Ogden Streets to carry the 100-year flood, flooding occurs overland to an old channel, through a detention pond, and rejoins Harvard Gulch. These flows

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through Logan Park are referred to in this study as Harvard Gulch Overflow.

Dry Gulch (Harvard Gulch Tributary) consists of two 43-inch by 68-inch reinforced-concrete pipe culverts along the entire study reach. These culverts carry only 250 cfs of the 1,330 cfs 100-year flood event. The remaining floodwaters flow overland through a park area and continue down Pearl Street to the confluence with Harvard Gulch.

Peak discharges for Goldsmith Gulch and Southmoor Park Tributary were determined as part of the 1976 Urban Drainage and Flood Control District Flood Hazard Area Delineation report (Reference 15). The 10- and 100-year discharges were computed using the Colorado Urban Hydrograph Procedure (Reference 35). The 50- and 500-year discharges were obtained by interpolation and extrapolation of the frequency-discharge curve.

Southmoor Park serves as a detention pond to reduce flows along Southmoor Park Tributary. Reduced flows are released through an intake pipe to a culvert located under the detention pond and Hampden Avenue (State Highway 30).

Peak discharges for Sanderson Gulch and Weir Gulch were determined as part of the 1972 Urban Drainage and Flood Control District Major Drainageway Planning report (Reference 36). The 10-, 50-, and 100-year discharges were calculated using the Colorado Urban Hydrograph Procedure (Reference 35) for fully developed basin conditions. The 500-year discharge was extrapolated from the data. Peak discharges on Weir Gulch downstream of Barnum Lake were revised to reflect channel improvements at Barnum Lake and increased culvert capacity at West 6th Avenue (U.S. Highway 6).

Peak discharges for First Avenue Tributary and Dakota Avenue Tributary were determined as part of the 1977 Urban Drainage and Flood Control District Flood Hazard Area Delineation report (Reference 20). Those discharges were calculated in accordance with the Colorado Urban Hydrograph Procedure (Reference 35) assuming fully developed basin conditions. The subbasin hydrographs were routed downstream. The Puls Method was used to calculate discharges at locations where storage had a significant effect.

Peak discharges for Sand Creek were determined as part of the 1977 Urban Drainage and Flood Control Flood Hazard Area Delineation report (Reference 37). The hydrologic analysis was based on the development of a surface-runoff model of the Sand Creek basin using the runoff block of the U.S. Environmental Protection Agency's Storm Water Management Model (Reference 32). Discharge hydrographs developed from the model were then routed along the main stem of Sand Creek by use of an unsteady flow-routing procedure developed by James A. Harder and modified by the Missouri River Division of

the U.S. Army Corps of Engineers. Discharge probability relationships were developed by inserting precipitation-frequency values (Reference 38). The discharges were calculated for fully developed basin conditions.

Peak discharge-drainage area relationships for all streams studied in detail are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 39).

A brief discussion of the hydraulic analysis of each stream studied in detail follows:

Clear Creek

Cross section data, Manning's "n" values, and starting water-surface elevations were obtained from the 1979 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Clear Creek (Reference 22). Cross section data for the HEC-2 analysis were compiled from topographic mapping (Reference 40). Typical roughness or Manning's "n" values used were 0.025 to 0.045 for the channel and 0.040 to 0.075 for the overbank areas.

Bear Creek

Cross section data, Manning's "n" values, and starting water-surface elevations were developed for use in the 1979 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Bear Creek (Reference 41). Cross section data were obtained photogrammetrically by digitizing cross sections marked on aerial photographs of the stream channel and flood plain (Reference 42). The digitized cross section data were supplemented with cross sections taken from topographic mapping (Reference 43) developed from the aerial photography. All bridge cross sections were obtained from actual field measurements. Roughness coefficients for the channel and overbank areas were estimated by field inspection of the study area. Manning's "n" values were 0.035 in the channel and from 0.025 to 0.090 in the overbank areas.

Additional cross sections were included from channel improvement plans due to recent grading and channel improvements in the vicinity of Lowell Boulevard.

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Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Clear Creek					
At West 52nd Avenue	575	3,710	9,750	14,520	31,000
Bear Creek					
At South Sheridan Boulevard (State Highway 95)	-[1]	4,120	6,710	7,910	11,800
Cherry Creek					
Upstream of Confluence With Goldsmith Gulch	7	1,550	3,000	3,950	6,700
At Mouth	25.2	4,100	7,500	9,700	13,300
Lakewood Gulch					
At Mouth	16	5,130	5,300	6,010	7,900
Lakewood Gulch Overflow					
Downstream of the Divergence From Lakewood Gulch	-[1]	1,100	2,700	3,200	5,750
Dry Gulch (Lakewood Gulch Tributary)					
At Mouth	3.7	1,520	1,980	2,180	2,600
Harvard Gulch					
At South Race Street	3.8	2,400	3,000	3,250	3,900
At South Logan Street	6.3	3,360	4,400	4,860	5,900

[1]Data Not Available

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Table 2. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Harvard Gulch Overflow					
Upstream of South Ogden Street	-[1]	720	1,200	1,600	1,900
Dry Gulch (Harvard Gulch Tributary)					
At Mouth	1.8	650	950	1,080	1,400
West Harvard Gulch					
At South Federal Boulevard (State Highway 88)	0.6	700	900	1,000	1,200
At Mouth	1.4	1,300	1,630	1,785	2,100
Goldsmith Gulch					
At Belleview Avenue	2.6	1,250	1,930	2,250	3,200
At Mouth	8.0	3,880	4,900	5,300	6,320
Southmoor Park Tributary					
At Mouth	1.4	500	500	500	930
Sanderson Gulch					
At South Sheridan Boulevard (State Highway 95)	5.3	1,030	1,400	1,550	1,900
At West South Platte River Drive	7.6	1,650	2,200	2,450	3,000
Weir Gulch					
At Mouth	-[1]	1,850	2,340	2,530	3,190
First Avenue Tributary					
At Mouth	1.5	410	670	740	1,030
Dakota Avenue Tributary					
At Mouth	0.7	200	300	355	465
Sand Creek					
Downstream of Confluence with Westerly Creek	184	10,000	22,400	30,000	33,000

[1]Data Not Available

Cherry Creek

Cross section data, Manning's "n" values, and starting water-surface elevations were obtained from the 1976 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Cherry Creek (Reference 10).

Revised cross sections reflecting recent channel improvements in the areas of Bannock Street to First Avenue were obtained from the Wastewater Management Division of the Denver Department of Public Works Cherry Creek channel improvements reports (References 44 and 45).

Lakewood Gulch and Lakewood Gulch Overflow

Cross section data, Manning's "n" values, and starting water-surface elevations were obtained from the 1979 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Lakewood Gulch (Reference 46). The starting water-surface elevations for Lakewood Gulch were established using the elevation of a 10-year flood on the South Platte River at its confluence with Lakewood Gulch. The starting water-surface elevations for Lakewood Gulch Overflow were taken from the Lakewood Gulch profile at the confluence with Lakewood Gulch Overflow. Values of Manning's "n" on Lakewood Gulch were selected in order to model the roughness of the streambed and overbank areas. Each cross section or group of cross sections was evaluated and assigned a Mannings "n" value for the left overbank, the channel, and the right overbank. Selected Manning's "n" values ranged from as low as 0.02 for street crossings and parking lots to as high as 0.08 for overbank areas restricted by buildings or debris. At a typical channel section, consisting of a natural channel with natural overbank areas, the generally selected Manning's "n" values were between 0.030 and 0.035 in the main channel, and between 0.045 and 0.050 in the overbank areas. In overbank areas that were restricted by buildings, Manning's "n" values of 0.08 were used when it was felt that a flow of water could occur through the developed area.

Dry Gulch (Lakewood Gulch Tributary)

Cross section data, Manning's "n" values, and starting water-surface elevations were obtained from the 1977 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Dry Gulch and its tributaries (Reference 12). Values of Manning's "n" used in that report ranged from as low as 0.017 for streets and parking lots to as high as 0.100 for overbank areas restricted by buildings. In general, areas of natural channel section with natural overbanks were assigned Mannings "n" values of approximately 0.045 and 0.080. Where buildings represented significant obstructions to the channel flow, they were represented in the cross sections as total blockages. Starting water-surface elevations were determined from the Lakewood Gulch flood profiles.

Harvard Gulch, Harvard Gulch Overflow, West Harvard Gulch, and Dry Gulch (Harvard Gulch Tributary)

Cross section data, Manning's "n" values, and starting water-surface elevations were developed for use in the 1979 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Harvard Gulch, West Harvard Gulch, and Dry Gulch (Harvard Gulch Tributary) (Reference 14). Cross section information was obtained photogrammetrically by digitizing cross sections marked on aerial photographs of the stream channel and flood plain (Reference 47). The digitized cross section information was supplemented with cross sections taken from topographic mapping (Reference 48) developed from the aerial photography. All cross sections at bridges were obtained from field measurement.

Estimates of channel and overbank roughness coefficients were made after field investigation of the study areas. Manning's "n" values ranged from 0.015 to 0.040 in the channel and from 0.035 to 0.120 in the overbank areas.

Starting water-surface elevations for Harvard Gulch and West Harvard Gulch were obtained at control sections. The control on Harvard Gulch was a broadcrested weir flow section over South Logan Street, and on West Harvard Gulch, a broadcrested weir section over West South Platte River Drive. Starting water-surface elevations for Harvard Gulch Overflow were taken from the Harvard Gulch profile. For Dry Gulch (Harvard Gulch Tributary), the starting water-surface elevations were also taken from the Harvard Gulch profile because these streams are likely to peak at close to the same time.

Areas of shallow flooding along West Harvard Gulch and Dry Gulch (Harvard Gulch Tributary) were determined using normal-depth calculations. Shallow flooding along Harvard Gulch was determined using normal-depth calculations and a network analysis of flood-flows and depths along roads.

Goldsmith Gulch and Southmoor Park Tributary

Cross section data, Mannings "n" values, and starting water-surface elevations were developed for use in the 1976 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Goldsmith Gulch and its tributaries (Reference 15). Cross section information was obtained from topographic maps (Reference 49). Typical Manning's "n" values for Goldsmith Gulch and Southmoor Park Tributary ranged from 0.030 to 0.045 in the channel, and from 0.035 to 0.055 in the overbank areas. Starting water-surface elevations for Southmoor Park Tributary were taken from the Goldsmith Gulch profiles. Starting water-surface elevations for Goldsmith Gulch were determined using a rating curve.

Additional cross sections, added at a berm along Goldsmith Gulch near the confluence with Cherry Creek, were taken from Cherry Creek

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improvement plans (Reference 44). Additional cross section data from improvement plans were included along Goldsmith Gulch and Southmoor Park Tributary for the more recent construction of Eastman Avenue.

Sanderson Gulch

Cross section data on Sanderson Gulch used in the hydraulic analyses were taken from construction drawings, as-built construction drawings, field surveys, and topographic mapping (Reference 50). The starting water-surface elevations were computed using the West South Platte River Drive crossing as a control. Roughness coefficients were estimated after field investigation and ranged from 0.015 to 0.060 in the channel and from 0.035 to 0.100 in the overbank areas.

At Lipan Street along Sanderson Gulch, flows escape along the left overbank and extend to the South Platte River as shallow flooding. These shallow flooding areas were determined using normal-depth calculations.

Weir Gulch

Cross section data for Weir Gulch were obtained from construction drawings (References 25-29), field surveys, and topographic mapping (Reference 50). The starting water-surface elevations were obtained assuming a simultaneous 10-year runoff event on the South Platte River. Roughness coefficients were determined by field inspection on the channel and overbank areas, and ranged from 0.013 to 0.050 and from 0.013 to 0.055, respectively.

First Avenue Tributary and Dakota Avenue Tributary

Cross section data, Manning's "n" values, and starting water-surface elevations were obtained from the 1977 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for the Weir Gulch tributaries (Reference 20). Cross section data were compiled from topographic maps (Reference 51). Starting water-surface elevations were determined by the Weir Gulch water-surface profiles. The Manning's "n" values were 0.080 for the channel and overbanks on Dakota Avenue Tributary and ranged from 0.025 to 0.080 for the channel and overbanks on First Avenue Tributary.

Flooding downstream of Sheridan Boulevard (State Highway 95) on Dakota Avenue Tributary has been determined to be shallow flooding with an average depth of 1.0 foot. Areas of shallow flooding were determined using the U.S. Army Corps of Engineers HEC-2 computer program (Reference 39) and normal-depth calculations.

Sand Creek

Cross section data, Manning's "n" values, and starting water-surface elevations were obtained from the 1977 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Sand

Creek (Reference 37). Cross section data were compiled from topographic maps (Reference 52). Manning's "n" values ranged from 0.036 to 0.044 in the channel and from 0.035 to 0.100 in the overbank areas. Backwater computations for determination of the flood profiles were started at the Burlington Ditch Weir, located within the City of Commerce City, where critical depth was assumed.

Between Quebec Street and Havana Street, shallow flooding extends north from Sand Creek, inundating large areas of the Stapleton International Airport with depths averaging from less than 1 foot to 3 feet. Downstream of Quebec Street, shallow flooding extends west from Sand Creek with depths averaging less than 1 foot. Normal-depth calculations were used to determine depths and extent of shallow flooding areas.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the flood profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Generally, the distances on the flood profiles correspond to distances measured along the centerline of the designated watercourses. In several areas, however, the meandering nature of the low-flow streambeds necessitated use of distances measured along the centerline of the 100-year flow paths. On the maps, these flow lines, used to establish the respective profile distances, are delineated and labeled as Profile Base Lines.

A portion of flooding on Sanderson Gulch from South Sheridan Boulevard (State Highway 95) downstream to cross section BQ has been labeled with a Profile Base Line. Flooding backs up at the culvert under South Sheridan Boulevard and flows over the road at a low spot just north of the culvert.

No flood profiles have been presented for Dakota Avenue Tributary because the entire 100-year flood plain downstream of Sheridan Boulevard (State Highway 95) has been determined to be shallow flooding with average depths of 1.0 foot.

Hydraulic data used for the South Platte River were obtained from a U.S. Army Corps of Engineers Preliminary Flood Plain Information Report (Reference 53).

The approximate 100-year elevations along the South Platte River were computed using the U.S. Army Corps of Engineers HEC-2 computer

model (Reference 39) calibrated using high-water marks from the 1973 flood. Manning's "n" values ranged from 0.030 to 0.039 in the channel and from 0.045 to 0.100 in the overbank areas. Starting water-surface elevations were assumed at normal-depth. Both normal and special bridge routines were used in the HEC-2 program to determine bridge losses. Cross section data were taken from topographic maps (References 54, 55, and 56).

The approximate 100-year elevations along Westerly Creek were computed using the U.S. Army Corps of Engineers HEC-2 computer model (Reference 39). Manning's "n" values and cross section data in some portions of Westerly Creek were obtained from the 1977 Urban Drainage and Flood Control District Flood Hazard Area Delineation report for Westerly Creek (Reference 57). Additional cross section data were obtained from construction drawings for recent channel improvements (Reference 58). Starting water-surface elevations were determined in the 1977 Major Drainageway Planning report for Westerly Creek (Reference 11).

Elevations for Coon Creek, First Creek, First Creek Tributary, Sloans Lake Basin, and Marston Lake North Drainage Basin, which are presented in this Flood Insurance Study as approximate study areas, were determined previously as part of the following Urban Drainage and Flood Control District reports: the Flood Hazard Area Delineation report for Dutch Creek, Lilley Gulch, Coon Creek, and Three Lakes Tributary (Reference 59); the Major Drainageway Planning report for First Creek (Reference 60); the Flood Hazard Area Delineation report for Sloans Lake Basin (Reference 61); and the Flood Hazard Area Delineation report for Marston Lake North Drainage Basin (Reference 62).

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by the FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries

have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:1,200 and 1:24,000, with contour intervals of 2 and 10 feet (References 40, 43, 48-52, 56, 63, 64, and 65).

Boundaries for the shallow flooding areas were delineated using topographic maps at scales of 1:1,200 and 1:24,000, with contour intervals of 2 and 10 feet (References 48, 50, 51, 52, and 56), in conjunction with the previously determined elevations.

For the streams studied by approximate methods, the boundaries of the 100-year flood were delineated on topographic maps at scales of 1:600 and 1:1,200, with contour intervals of 1 and 2 feet (References 54, 55, and 66-70).

Approximate flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (Reference 71).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

A floodway was not computed for Cherry Creek because the determination of a floodway was not within the scope of this study.

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Harvard Gulch, downstream of South Logan Street, and Dakota Avenue Tributary are shallow flooding areas for which the floodway concept is not applicable.

No floodway has been presented for Harvard Gulch between South Ogden and South Logan Streets and for Harvard Gulch Overflow due to the fully developed nature of this area.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Clear Creek								
A	38,117	177/120[2]	1,326	10.9	5,268.1	5,268.1	5,268.1	0.0
B	38,820	272	1,179	12.3	5,275.3	5,275.3	5,275.3	0.0
C	39,600	205[3]	1,340	10.8	5,280.6	5,280.6	5,280.9	0.3

[1]Feet Above Mouth [2]Width/Width Within Corporate Limits [3]Floodway Lies Entirely Outside Corporate Limits

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TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

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FLOODWAY DATA

CLEAR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Bear Creek								
A	2,417	70[2]	810	10.1	5,309.0	5,309.0	5,309.1	0.1
B	2,656	200[2]	1,825	4.5	5,310.9	5,310.9	5,310.9	0.0
C	3,051	200	1,285	6.3	5,310.9	5,310.9	5,310.9	0.0
D	3,821	300	1,116	7.3	5,311.9	5,311.9	5,312.0	0.1
E	4,336	184	857	9.5	5,313.8	5,313.8	5,313.8	0.0
F	4,716	218	1,363	6.0	5,315.5	5,315.5	5,316.0	0.5
G	5,151	250	1,464	5.6	5,316.0	5,316.0	5,316.6	0.6
H	5,356	257	1,009	8.1	5,316.5	5,316.5	5,316.6	0.1
I	5,501	257	1,041	7.8	5,317.9	5,317.9	5,317.9	0.0
J	5,561	332	954	8.5	5,318.7	5,318.7	5,319.4	0.7
K	6,221	300	1,267	6.4	5,321.9	5,321.9	5,322.8	0.9
L	7,181	187	1,152	7.1	5,324.4	5,324.4	5,325.2	0.8
M	7,451	145	694	11.7	5,325.9	5,325.9	5,325.9	0.0
N	7,631	130	747	10.9	5,327.8	5,327.8	5,328.6	0.8
O	7,711	113	962	8.5	5,330.0	5,330.0	5,330.0	0.0
P	7,931	85	571	14.3	5,330.0	5,330.0	5,330.0	0.0
Q	8,591	75	667	12.2	5,333.7	5,333.7	5,333.8	0.1
R	8,761	70	533	15.3	5,337.4	5,337.4	5,337.5	0.1
S	8,866	70	625	13.0	5,339.7	5,339.7	5,339.9	0.2
T	9,001	117	999	8.2	5,342.1	5,342.1	5,342.3	0.2
U	9,701	353	2,317	3.5	5,343.4	5,343.4	5,344.2	0.8
V	10,461	180	1,324	6.2	5,343.5	5,343.5	5,344.5	1.0
W	10,841	164	1,235	6.6	5,344.8	5,344.8	5,345.3	0.5
X	11,361	189	1,443	5.6	5,346.5	5,346.5	5,347.4	0.9
Y	11,751	178	1,381	5.9	5,347.9	5,347.9	5,348.4	0.5
Z	12,231	145	1,063	7.7	5,348.7	5,348.7	5,349.2	0.5

[1]Feet Above South Federal Boulevard (State Highway 88) [2]Floodway Lies Entirely Outside Coporate Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

BEAR CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Bear Creek (Cont'd)								
AA	13,421	153	1,085	7.5	5,352.0	5,352.0	5,352.8	0.8
AB	13,806	138	903	9.0	5,352.6	5,352.6	5,353.6	1.0
AC	14,246	121	805	10.1	5,355.2	5,355.2	5,355.5	0.3
AD	14,731	230	1,544	5.3	5,357.1	5,357.1	5,358.1	1.0
AE	15,021	194/160[2]	988	8.3	5,357.5	5,357.5	5,358.4	0.9
AF	15,371	140	977	8.3	5,360.2	5,360.2	5,361.0	0.8
AG	15,951	110	811	10.0	5,364.3	5,364.3	5,364.5	0.2
AH	16,391	82/40[2]	684	11.9	5,368.1	5,368.1	5,368.1	0.0
AI	16,801	230/170[2]	1,670	4.9	5,371.4	5,371.4	5,372.4	1.0
AJ	17,116	112/90[2]	1,049	7.8	5,372.0	5,372.0	5,372.8	0.8
AK	17,476	80	601	13.6	5,373.2	5,373.2	5,373.4	0.2
AL	18,141	99	969	8.4	5,378.4	5,378.4	5,379.2	0.8
AM	18,581	85	728	11.2	5,379.6	5,379.6	5,380.3	0.7

[1]Feet Above South Federal Boulevard (State Highway 88) [2]Width/Width Within Corporate Limits

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

BEAR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Lakewood Gulch								
A	317	195	981	6.1	5,196.7	5,196.7	5,196.7	0.0
B	340	195	995	6.0	5,196.8	5,196.8	5,196.8	0.0
C	550	245	832	8.1	5,197.6	5,197.6	5,197.6	0.0
D	610	165	1,188	5.6	5,198.9	5,198.9	5,199.0	0.1
E	905	200	776	10.0	5,201.1	5,201.1	5,201.1	0.0
F	1,295	124	848	12.9	5,204.2	5,204.2	5,204.5	0.3
G	1,520	167	1,211	9.0	5,207.6	5,207.6	5,207.7	0.1
H	1,820	324	2,623	4.2	5,209.2	5,209.2	5,209.5	0.3
I	2,087	174	981	11.1	5,209.2	5,209.2	5,209.3	0.1
J	2,490	104	650	16.8	5,215.3	5,215.3	5,215.3	0.0
K	2,650	116	1,140	9.6	5,219.2	5,219.2	5,219.5	0.3
L	3,225	141	903	12.1	5,221.7	5,221.7	5,221.7	0.0
M	3,245	148	1,315	8.3	5,225.2	5,225.2	5,225.2	0.0
N	3,585	86	774	14.1	5,225.2	5,225.2	5,225.2	0.0
O	4,165	157	1,148	9.5	5,229.8	5,229.8	5,230.3	0.5
P	4,392	150	1,108	9.9	5,231.2	5,231.2	5,231.5	0.3
Q	4,398	170	1,420	7.7	5,232.5	5,232.5	5,232.8	0.3
R	4,600	180	1,121	9.8	5,236.1	5,236.1	5,236.1	0.0
S	4,690	291	2,363	4.6	5,242.4	5,242.4	5,242.4	0.0
T	5,080	90	987	11.1	5,242.4	5,242.4	5,242.4	0.0
U	5,225	120	1,562	7.0	5,247.3	5,247.3	5,247.3	0.0
V	5,530	183	2,074	5.3	5,248.0	5,248.0	5,248.1	0.1
W	5,960	217	1,779	6.2	5,250.0	5,250.0	5,250.3	0.3
X	5,985	217	2,348	4.7	5,252.6	5,252.6	5,252.9	0.3
Y	6,530	105	1,038	10.5	5,253.0	5,253.0	5,253.4	0.4
Z	7,030	71	640	12.6	5,255.0	5,255.0	5,255.0	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

LAKEWOOD GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Lakewood Gulch (Cont'd)								
AA	7,060	86	569	14.2	5,258.0	5,258.0	5,258.0	0.0
AB	7,110	180	1,232	6.5	5,261.7	5,261.7	5,261.7	0.0
AC	7,380	110	911	8.9	5,262.1	5,262.1	5,262.1	0.0
AD	7,940	120	925	8.7	5,266.9	5,266.9	5,267.5	0.6
AE	8,070	73	799	10.1	5,267.0	5,267.0	5,267.5	0.5
AF	8,280	121	1,374	5.9	5,268.4	5,268.4	5,269.0	0.6
AG	8,410	139	1,594	5.2	5,269.1	5,269.1	5,269.7	0.6
AH	8,930	143	999	8.1	5,271.2	5,271.2	5,271.8	0.6
AI	8,985	149	1,041	7.8	5,273.4	5,273.4	5,273.9	0.5
AJ	9,390	218	886	9.1	5,277.3	5,277.3	5,277.6	0.3
AK	9,520	340	945	8.5	5,280.4	5,280.4	5,280.6	0.2
AL	9,790	121	692	11.7	5,283.7	5,283.7	5,283.7	0.0
AM	10,190	83	577	13.7	5,285.5	5,285.5	5,286.0	0.5
AN	10,435	93	799	9.9	5,288.9	5,288.9	5,288.9	0.0
AO	10,760	167	695	11.4	5,296.8	5,296.8	5,296.8	0.0
AP	10,900	188	1,285	6.1	5,299.0	5,299.0	5,299.6	0.6
AQ	11,540	74	560	14.0	5,302.5	5,302.5	5,302.5	0.0
AR	11,900	86	761	10.3	5,307.0	5,307.0	5,307.7	0.7
AS	12,150	209	743	10.5	5,314.0	5,314.0	5,314.0	0.0
AT	12,285	231	780	10.0	5,315.0	5,315.0	5,315.0	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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LAKEWOOD GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Lakewood Gulch Overflow								
A	230	180	494	6.5	5,196.0	5,196.0	5,196.5	0.5
B	470	143	469	6.8	5,197.1	5,197.1	5,197.4	0.3
C	555	110	326	9.8	5,198.4	5,198.4	5,198.6	0.2
D	700	107	332	9.6	5,202.2	5,202.2	5,202.5	0.3
E	875	82	298	10.7	5,203.9	5,203.9	5,204.2	0.3

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

LAKEWOOD GULCH OVERFLOW

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Dry Gulch (Lakewood Gulch Tributary)								
A	275	35	171	12.8	5,253.0	5,249.3[2]	5,249.3[2]	0.0
B	465	35	179	12.2	5,253.4	5,253.4	5,253.4	0.0
C	505	25	216	10.1	5,258.1	5,258.1	5,258.4	0.3
D	610	107	1,259	1.7	5,268.7	5,268.7	5,269.1	0.4
E	655	194	1,809	1.2	5,268.8	5,268.8	5,269.2	0.4
F	945	171	1,482	1.5	5,268.8	5,268.8	5,269.2	0.4
G	1,190	105	820	2.7	5,268.8	5,268.8	5,269.2	0.4
H	1,330	50	578	3.8	5,269.0	5,269.0	5,269.2	0.2
I	1,390	122	863	2.5	5,269.2	5,269.2	5,269.4	0.2
J	1,618	47	305	7.1	5,269.2	5,269.2	5,269.4	0.2
K	2,112	38	177	12.4	5,272.6	5,272.6	5,272.6	0.0
L	2,615	67	289	7.6	5,280.5	5,280.5	5,280.5	0.0
M	3,115	52	216	10.1	5,286.0	5,286.0	5,286.4	0.4
N	3,575	70	281	7.8	5,292.3	5,292.3	5,292.3	0.0
O	4,040	73	267	8.2	5,297.4	5,297.4	5,297.6	0.2
P	4,120	25	201	10.9	5,302.0	5,302.0	5,302.0	0.0
Q	4,170	73	498	4.4	5,304.3	5,304.3	5,304.3	0.0
R	4,440	64	332	6.6	5,304.7	5,304.7	5,304.8	0.1
S	4,520	15	130	16.7	5,308.8	5,308.8	5,308.9	0.1
T	4,675	15	126	17.3	5,311.5	5,311.5	5,311.6	0.1
U	4,680	15	197	11.0	5,316.0	5,316.0	5,316.0	0.0
V	4,770	121	1,110	2.0	5,318.9	5,318.9	5,319.0	0.1
W	5,200	70	528	4.1	5,318.9	5,318.9	5,319.0	0.1

[1]Feet Above Mouth [2]Elevation Computed Without Consideration of Backwater Effect From Lakewood Gulch

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

DRY GULCH (LAKEWOOD GULCH TRIBUTARY)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Harvard Gulch								
H	7,115	58	313	6.8	5,326.7	5,326.7	5,326.7	0.0
I	7,430	179	846	3.8	5,327.9	5,327.9	5,328.0	0.1
J	7,710	119	427	7.6	5,328.0	5,328.0	5,328.2	0.2
K	7,765	119	582	5.6	5,328.7	5,328.7	5,328.7	0.0
L	8,045	98	383	8.5	5,329.7	5,329.7	5,329.7	0.0
M	8,095	98	539	6.0	5,331.0	5,331.0	5,331.2	0.2
N	8,200	69	320	10.2	5,331.5	5,331.5	5,331.6	0.1
O	8,425	125	739	4.4	5,337.2	5,337.2	5,338.0	0.8
P	8,702	84	428	7.6	5,337.2	5,337.2	5,338.0	0.8
Q	9,030	80	329	9.9	5,338.7	5,338.7	5,338.7	0.0
R	9,082	80	362	9.0	5,340.5	5,340.5	5,340.5	0.0
S	9,695	80	294	11.1	5,342.9	5,342.9	5,342.9	0.0
T	10,265	114	553	6.2	5,345.8	5,345.8	5,345.8	0.0
U	10,578	120	501	6.8	5,346.0	5,346.0	5,346.1	0.1
V	10,905	79	307	11.2	5,347.0	5,347.0	5,347.0	0.0
W	11,405	142	702	4.9	5,352.3	5,352.3	5,352.5	0.2
X	11,765	96	446	7.7	5,354.6	5,354.6	5,354.6	0.0
Y	11,825	85	457	7.5	5,355.9	5,355.9	5,355.9	0.0
Z	12,230	79	552	6.2	5,358.9	5,358.9	5,358.9	0.0
AA	12,402	103	512	6.7	5,359.6	5,359.6	5,359.6	0.0
AB	12,998	169	423	8.1	5,363.5	5,363.5	5,363.5	0.0
AC	13,385	205	700	4.9	5,368.0	5,368.0	5,368.2	0.2
AD	13,805	214	586	4.5	5,370.8	5,370.8	5,370.8	0.0
AE	14,235	125	435	6.1	5,374.4	5,374.4	5,374.4	0.0
AF	14,515	169	648	4.1	5,376.0	5,376.0	5,376.1	0.1
AG	14,640	71	364	7.3	5,376.7	5,376.7	5,376.7	0.0
AH	14,905	220	783	3.4	5,377.7	5,377.7	5,377.7	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

HARVARD GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Harvard Gulch (Cont'd)								
AI	15,045	200	482	5.5	5,378.0	5,378.0	5,378.0	0.0
AJ	15,425	83	370	7.2	5,384.0	5,384.0	5,384.0	0.0
AK	15,560	115	441	6.0	5,384.0	5,384.0	5,384.0	0.0
AL	15,760	92	390	6.8	5,385.2	5,385.2	5,385.2	0.0
AM	16,412	47	244	10.9	5,389.1	5,389.1	5,389.1	0.0
AN	16,680	63	367	7.2	5,392.3	5,392.3	5,392.6	0.3

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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HARVARD GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Dry Gulch (Harvard Gulch Tributary)								
A	145	150	370	2.9	5,305.0	5,305.0	5,305.0	0.0
B	300	112	505	2.1	5,305.1	5,305.1	5,305.1	0.0
C	500	160	252	4.3	5,305.4	5,305.4	5,305.4	0.0
D	750	115	224	4.8	5,305.7	5,305.7	5,305.8	0.1
E	1,110	81	161	6.7	5,312.4	5,312.4	5,312.4	0.0
F	1,340	85	157	6.9	5,314.3	5,314.3	5,314.3	0.0
G	1,535	168	464	2.3	5,315.5	5,315.5	5,315.5	0.0
H	1,712	97	173	6.2	5,315.5	5,315.5	5,315.5	0.0
I	1,880	69	156	6.7	5,319.3	5,319.3	5,319.3	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

DRY GULCH (HARVARD GULCH TRIBUTARY)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
West Harvard Gulch								
A	215	65	423	3.0	5,264.1	5,264.1	5,264.5	0.4
B	448	52	213	8.4	5,264.1	5,264.1	5,264.5	0.4
C	670	29	141	12.7	5,268.3	5,268.3	5,268.3	0.0
D	915	83	222	8.0	5,274.4	5,274.4	5,274.4	0.0
E	960	46	267	6.7	5,275.3	5,275.3	5,275.6	0.3
F	985	47	281	6.4	5,275.9	5,275.9	5,276.1	0.2
G	1,015	47	275	6.5	5,276.0	5,276.0	5,276.2	0.2
H	1,035	92/60[2]	190	8.2	5,288.2	5,288.2	5,288.2	0.0
I	3,770	179	714	1.5	5,346.4	5,346.4	5,346.4	0.0
J	4,035	76	195	1.6	5,346.4	5,346.4	5,346.4	0.0
K	4,515	29	125	11.6	5,353.9	5,353.9	5,353.9	0.0
L	4,690	16	103	14.5	5,357.5	5,357.5	5,357.5	0.0
M	4,850	131	114	1.9	5,369.4	5,369.4	5,369.5	0.1
N	5,050	84	390	3.2	5,369.4	5,369.4	5,369.5	0.1
O	5,545	32	115	10.8	5,373.9	5,373.9	5,373.9	0.0
P	5,688	33	116	10.8	5,376.5	5,376.5	5,376.5	0.0
Q	5,880	75	534	1.9	5,389.7	5,389.7	5,389.8	0.1
R	6,160	49	166	6.0	5,389.7	5,389.7	5,389.8	0.1
S	6,435	48	114	8.8	5,393.4	5,393.4	5,393.4	0.0

[1]Feet Above Mouth [2]Width/Width Within Corporate Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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WEST HARVARD GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	[1] DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Goldsmith Gulch								
A	200	743	5,327	0.8	5,396.8	5,396.8	5,397.8	1.0
B	1,062	224	895	1.3	5,401.6	5,401.6	5,402.6	1.0
C	1,544	123	424	9.5	5,406.1	5,406.1	5,406.5	0.4
D	1,663	244	757	2.0	5,410.4	5,410.4	5,410.8	0.4
E	2,290	152	635	8.3	5,415.0	5,415.0	5,415.0	0.0
F	2,530	246	961	5.5	5,416.7	5,416.7	5,416.7	0.0
G	2,723	325	1,410	3.7	5,417.7	5,417.7	5,417.9	0.2
H	3,035	170	624	8.4	5,418.6	5,418.6	5,418.7	0.1
I	3,146	211	747	7.0	5,419.9	5,419.9	5,420.0	0.1
J	3,613	117	538	9.7	5,421.9	5,421.9	5,421.9	0.0
K	4,175	155	719	7.2	5,428.3	5,428.3	5,428.3	0.0
L	5,915	275	1,595	3.2	5,436.4	5,436.4	5,437.3	0.9
M	6,600	75	399	12.8	5,439.5	5,439.5	5,439.5	0.0
N	7,465	82	540	9.3	5,444.7	5,444.7	5,445.4	0.7
O	8,800	69	379	13.1	5,452.2	5,452.2	5,452.2	0.0
P	8,965	602	3,028	1.6	5,458.4	5,458.4	5,458.4	0.0
Q	10,430	213	644	7.5	5,463.9	5,463.9	5,463.9	0.0
R	11,535	247	820	5.8	5,470.1	5,470.1	5,470.6	0.5
S	11,771	473	1,766	2.7	5,477.7	5,477.7	5,478.2	0.5
T	11,872	423	2,595	1.8	5,478.6	5,478.6	5,479.1	0.5
U	11,980	622	2,883	1.6	5,478.6	5,478.6	5,478.6	0.0
V	12,636	273	944	5.0	5,478.7	5,478.7	5,478.7	0.0
W	13,743	71	331	12.6	5,488.1	5,488.1	5,488.1	0.0
X	14,308	123	538	7.7	5,493.4	5,493.4	5,493.4	0.0
Y	14,515	86	373	10.6	5,494.3	5,494.3	5,494.3	0.0
Z	14,649	196	1,087	3.6	5,497.5	5,497.5	5,497.7	0.2

[1] Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

GOLDSMITH GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Goldsmith Gulch (Cont'd)								
AA	15,080	80	338	11.6	5,497.5	5,497.5	5,497.7	0.2
AB	15,445	77	531	7.2	5,500.3	5,500.3	5,400.7	0.4
AC	15,990	82	357	10.7	5,503.1	5,503.1	5,503.1	0.0
AD	16,320	68	463	8.3	5,504.9	5,504.9	5,505.5	0.6
AE	16,433	108	566	6.6	5,507.5	5,507.5	5,508.1	0.6
AF	16,788	73	334	11.1	5,508.7	5,508.7	5,509.1	0.4
AG	17,771	65	337	11.0	5,517.7	5,517.7	5,517.9	0.2
AH	18,670	120	413	8.3	5,525.8	5,525.8	5,526.1	0.3
AI	18,766	137	419	8.2	5,526.1	5,526.1	5,526.4	0.3
AJ	19,101	79	330	10.4	5,529.4	5,529.4	5,529.4	0.0
AK	19,188	301	1,847	1.9	5,534.1	5,534.1	5,534.1	0.0
AL	19,570	105	441	7.8	5,534.2	5,534.2	5,534.2	0.0
AM	19,606	138	625	5.5	5,536.6	5,536.6	5,536.6	0.0
AN	20,045	188	586	5.9	5,538.7	5,538.7	5,539.0	0.3
AO	20,273	253	952	3.6	5,542.6	5,542.6	5,543.3	0.7
AP	20,375	184	729	4.5	5,543.0	5,543.0	5,543.6	0.6
AQ	20,509	347	2,925	1.1	5,550.1	5,550.1	5,550.7	0.6
AR	20,838	290	1,883	1.7	5,550.1	5,550.1	5,550.7	0.6
AS	21,180	313	4,484	1.9	5,550.2	5,550.2	5,550.8	0.6
AT	21,830	368	1,261	2.2	5,555.0	5,555.0	5,555.6	0.6
AU	22,335	135	313	8.5	5,557.3	5,557.3	5,557.4	0.1
AV	22,733	136	443	6.0	5,560.6	5,560.6	5,561.0	0.4
AW	23,340	153	474	5.6	5,565.3	5,565.3	5,565.3	0.0
AX	24,160	110	420	6.3	5,571.6	5,571.6	5,572.2	0.6
AY	24,927	116	393	6.8	5,576.8	5,576.8	5,577.0	0.2
AZ	25,908	122	270	8.3	5,587.4	5,587.4	5,587.7	0.3

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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GOLDSMITH GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Southmoor Park Tributary								
A	622	90	558	0.9	5,486.2	5,486.2	5,487.1	0.9
B	815	27	59	8.4	5,489.6	5,489.6	5,489.6	0.0
C	1,180	138	448	1.1	5,497.2	5,497.2	5,497.2	0.0
D	1,548	35	64	7.7	5,497.6	5,497.6	5,497.6	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

SOUTHMOOR PARK TRIBUTARY

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sanderson Gulch								
A	118	140	715	4.7	5,244.1	5,244.1	5,244.1	0.0
B	450	70	442	5.6	5,244.5	5,244.5	5,244.5	0.0
C	623	106	531	5.3	5,249.0	5,249.0	5,249.0	0.0
D	689	114	460	8.5	5,249.3	5,249.3	5,249.3	0.0
E	900	30	468	7.1	5,258.5	5,258.5	5,258.5	0.0
F	1,570	128	538	6.6	5,259.9	5,259.9	5,259.9	0.0
G	1,878	170	341	9.7	5,261.1	5,261.1	5,261.1	0.0
H	1,895	184	616	6.1	5,266.4	5,266.4	5,266.4	0.0
I	2,289	125	645	5.3	5,267.6	5,267.6	5,267.6	0.0
J	2,305	110	564	6.0	5,267.6	5,267.6	5,267.6	0.0
K	2,657	120	253	13.1	5,268.1	5,268.1	5,268.1	0.0
L	2,784	156	1,515	2.2	5,280.0	5,280.0	5,280.0	0.0
M	3,150	130	1,385	2.4	5,280.1	5,280.1	5,280.1	0.0
N	3,229	125	1,270	2.7	5,280.1	5,280.1	5,280.1	0.0
O	4,044	85	488	6.9	5,280.4	5,280.4	5,280.4	0.0
P	4,074	62	257	11.6	5,281.4	5,281.4	5,281.4	0.0
Q	4,308	95	287	10.4	5,285.0	5,285.0	5,285.3	0.3
R	4,392	125	843	4.2	5,289.7	5,289.7	5,289.7	0.0
S	4,670	205	846	4.9	5,289.7	5,289.7	5,289.8	0.1
T	5,025	105	532	8.6	5,289.8	5,289.8	5,289.8	0.0
U	5,037	102	484	7.5	5,290.4	5,290.4	5,290.4	0.0
V	5,318	96	305	11.4	5,291.1	5,291.1	5,291.1	0.0
W	5,692	80	399	8.9	5,294.8	5,294.8	5,294.8	0.0
X	5,725	97	331	10.6	5,298.4	5,298.4	5,298.4	0.0
Y	6,206	88	791	4.1	5,302.7	5,302.7	5,302.7	0.0
Z	6,360	96	662	5.4	5,309.0	5,309.0	5,309.0	0.0

[1]Feet Above Mouth

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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SANDERSON GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sanderson Gulch (Cont'd)								
AA	6,514	79	291	11.1	5,309.0	5,309.0	5,309.0	0.0
AB	6,803	74	393	8.5	5,311.2	5,311.2	5,311.2	0.0
AC	7,660	129	239	13.0	5,314.0	5,314.0	5,314.0	0.0
AD	7,737	179	608	6.3	5,318.9	5,318.9	5,318.9	0.0
AE	8,074	74	505	5.9	5,319.9	5,319.9	5,319.9	0.0
AF	8,144	73	391	7.7	5,320.0	5,320.0	5,320.0	0.0
AG	8,465	173	567	6.6	5,324.4	5,324.4	5,324.4	0.0
AH	8,485	181	632	6.2	5,324.9	5,324.9	5,324.9	0.0
AI	8,900	46	302	10.0	5,325.5	5,325.5	5,325.5	0.0
AJ	9,011	168	234	12.8	5,326.7	5,326.7	5,326.7	0.0
AK	9,132	95	622	4.8	5,333.7	5,333.7	5,333.7	0.0
AL	9,585	105	600	5.3	5,334.8	5,334.8	5,334.8	0.0
AM	9,765	119	466	7.2	5,335.0	5,335.0	5,335.0	0.0
AN	9,818	163	585	6.6	5,335.4	5,335.4	5,335.4	0.0
AO	10,369	51	258	11.2	5,337.0	5,337.0	5,337.0	0.0
AP	10,466	55	395	6.5	5,341.3	5,341.3	5,341.3	0.0
AQ	10,728	40	280	9.8	5,341.4	5,341.4	5,341.7	0.3
AR	10,739	44	421	6.0	5,344.6	5,344.6	5,344.9	0.3
AS	11,335	43	207	12.5	5,347.1	5,347.1	5,347.1	0.0
AT	11,353	47	245	10.5	5,348.0	5,348.0	5,348.0	0.0
AU	11,463	85	474	5.2	5,350.1	5,350.1	5,350.1	0.0
AV	12,018	43	231	8.0	5,350.9	5,350.9	5,350.9	0.0
AW	12,140	80	752	2.6	5,360.3	5,360.3	5,360.3	0.0
AX	12,713	107	401	5.1	5,360.5	5,360.5	5,360.5	0.0
AY	12,736	107	460	4.3	5,361.2	5,361.2	5,361.2	0.0
AZ	13,033	89	297	6.7	5,361.5	5,361.5	5,361.5	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

SANDERSON GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sanderson Gulch (Cont'd)								
BA	13,309	35	275	6.7	5,365.2	5,365.2	5,365.2	0.0
BB	13,390	65	344	5.9	5,367.3	5,367.3	5,367.5	0.2
BC	13,874	99	271	7.3	5,368.2	5,368.2	5,368.2	0.0
BD	14,358	137	190	10.3	5,372.8	5,372.8	5,372.8	0.0
BE	14,368	140	395	5.9	5,374.9	5,374.9	5,374.9	0.0
BF	14,926	128	318	6.7	5,376.3	5,376.3	5,376.3	0.0
BG	15,310	160	207	9.8	5,383.1	5,383.1	5,383.1	0.0
BH	15,395	124	414	5.7	5,386.0	5,386.0	5,386.1	0.1
BI	15,933	58	253	7.1	5,386.7	5,386.7	5,386.7	0.0
BJ	16,361	53	340	5.1	5,388.8	5,388.8	5,388.8	0.0
BK	16,389	58	162	10.2	5,390.4	5,390.4	5,390.4	0.0
BL	16,674	64	283	7.7	5,395.9	5,395.9	5,395.9	0.0
BM	17,084	41	254	8.2	5,398.3	5,398.3	5,398.3	0.0
BN	17,153	63	350	7.5	5,402.9	5,402.9	5,402.9	0.0
BO	17,536	44	199	7.8	5,404.9	5,404.9	5,404.9	0.0
BP	17,871	40	136	11.4	5,407.6	5,407.6	5,407.6	0.0
BQ	17,975	163	209	7.4	5,409.8	5,409.8	5,409.8	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

41

SANDERSON GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Weir Gulch								
A	142	72	750	3.4	5,202.2	5,202.2	5,202.2	0.0
B	295	140	1,448	1.7	5,202.4	5,202.4	5,202.4	0.0
C	605	85	301	8.4	5,202.4	5,202.4	5,202.4	0.0
D	661	70	322	7.9	5,202.4	5,202.4	5,202.5	0.1
E	811	77	359	7.0	5,203.2	5,203.2	5,203.2	0.0
F	901	25	201	12.6	5,203.2	5,203.2	5,203.2	0.0
G	1,401	25	170	14.9	5,208.7	5,208.7	5,208.7	0.0
H	1,601	25	170	14.9	5,210.6	5,210.6	5,210.7	0.1
I	1,651	50	207	12.2	5,212.4	5,212.4	5,212.4	0.0
J	2,063	44	255	9.9	5,215.1	5,215.1	5,215.1	0.0
K	2,692	58	853	3.1	5,238.3	5,238.3	5,238.4	0.1
L	3,292	64	1,086	2.4	5,238.3	5,238.3	5,238.5	0.2
M	3,587	42	495	5.3	5,238.3	5,238.3	5,238.5	0.2
N	4,370	500	5,698	0.6	5,258.5	5,258.5	5,258.5	0.0
O	4,660	421	4,877	0.7	5,258.5	5,258.5	5,258.5	0.0
P	5,160	293	3,357	1.0	5,258.5	5,258.5	5,258.5	0.0
Q	5,360	112	1,077	3.2	5,258.5	5,258.5	5,258.5	0.0
R	5,825	65	596	5.9	5,258.5	5,258.5	5,258.5	0.0
S	5,855	36	425	8.2	5,258.5	5,258.5	5,258.5	0.0
T	6,122	35	339	10.3	5,263.8	5,263.8	5,263.8	0.0
U	6,145	75	414	8.5	5,263.8	5,263.8	5,263.8	0.0
V	6,245	73	442	7.9	5,263.8	5,263.8	5,263.8	0.0
W	6,395	120	933	3.8	5,265.2	5,265.2	5,265.6	0.4
X	6,695	88	351	9.6	5,268.4	5,268.4	5,268.4	0.0
Y	6,829	169	647	5.2	5,271.7	5,271.7	5,271.7	0.0
Z	6,980	70	587	5.7	5,273.0	5,273.0	5,273.0	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

WEIR GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Weir Gulch (Cont'd)								
AA	9,522	20	204	15.7	5,288.2	5,288.2	5,289.2	1.0
AB	9,642	41	223	14.3	5,291.4	5,291.4	5,291.5	0.1
AC	9,693	20	185	17.3	5,291.6	5,291.6	5,291.6	0.0
AD	9,742	240	749	4.3	5,296.7	5,296.7	5,296.7	0.0
AE	9,849	190	614	4.2	5,296.9	5,296.9	5,296.9	0.0
AF	9,924	240	747	3.5	5,297.8	5,297.8	5,297.8	0.0
AG	9,968	90	455	5.7	5,297.8	5,297.8	5,297.8	0.0
AH	10,290	70	371	7.0	5,298.9	5,298.9	5,299.7	0.8
AI	10,488	96	454	5.7	5,300.6	5,300.6	5,300.7	0.1
AJ	10,555	55	245	10.6	5,300.6	5,300.6	5,300.7	0.1
AK	10,802	48	330	7.9	5,303.4	5,303.4	5,303.9	0.5
AL	11,055	69	430	6.0	5,304.9	5,304.9	5,305.5	0.6
AM	11,340	61	440	5.9	5,305.9	5,305.9	5,306.6	0.7
AN	11,465	25	175	14.9	5,305.9	5,305.9	5,306.6	0.7
AO	11,610	25	173	15.0	5,308.4	5,308.4	5,308.4	0.0
AP	11,805	25	256	10.2	5,310.2	5,310.2	5,310.2	0.0
AQ	11,816	157	710	3.7	5,315.5	5,315.5	5,315.5	0.0
AR	11,855	175	798	3.3	5,315.7	5,315.7	5,315.7	0.0
AS	12,555	70	386	6.7	5,316.3	5,316.3	5,316.8	0.5
AT	12,738	85	841	3.1	5,321.3	5,321.3	5,321.9	0.6
AU	13,303	48	404	6.4	5,321.8	5,321.8	5,322.4	0.6
AV	13,359	51	576	4.5	5,325.3	5,325.3	5,326.0	0.7
AW	13,714	33	278	9.4	5,325.5	5,325.5	5,326.2	0.7
AX	13,906	88	1,226	2.1	5,343.5	5,343.5	5,343.5	0.0
AY	13,961	125	1,360	1.9	5,343.5	5,343.5	5,343.5	0.0
AZ	14,241	312	2,129	1.2	5,343.6	5,343.6	5,343.6	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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WEIR GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Weir Gulch (Cont'd)								
BA	14,981	109	634	4.0	5,343.7	5,343.7	5,343.7	0.0
BB	15,251	45	243	10.5	5,344.2	5,344.2	5,344.3	0.1
BC	15,349	46	374	5.5	5,347.8	5,347.8	5,347.8	0.0
BD	15,699	146	267	6.4	5,352.9	5,352.9	5,353.3	0.4
BE	15,834	67	572	3.5	5,353.9	5,353.9	5,354.7	0.8
BF	16,047	170	730	2.3	5,354.1	5,354.1	5,354.9	0.8
BG	16,382	171	675	3.0	5,354.6	5,354.6	5,355.6	1.0
BH	16,457	95	434	4.5	5,356.8	5,356.8	5,357.4	0.6
BI	16,752	80	441	4.4	5,357.6	5,357.6	5,358.2	0.6
BJ	17,472	63	316	6.2	5,360.4	5,360.4	5,360.5	0.1
BK	17,757	52	219	8.9	5,362.3	5,362.3	5,362.4	0.1
BL	17,837	57	289	6.7	5,364.0	5,364.0	5,364.0	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

WEIR GULCH

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
First Avenue Tributary								
A	300	213	351	2.4	5,300.6	5,300.6	5,300.9	0.3
B	425	103	138	4.4	5,302.4	5,302.4	5,302.8	0.4
C	522	30	123	4.9	5,302.4	5,302.4	5,303.0	0.6
D	725	38	121	5.0	5,305.0	5,305.0	5,305.0	0.0
E	1,125	109	182	3.4	5,313.2	5,313.2	5,313.9	0.7
F	1,483	74	135	4.2	5,320.6	5,320.6	5,321.4	0.8
G	1,642	98	227	2.5	5,322.8	5,322.8	5,323.4	0.6
H	1,832	34	108	6.9	5,322.8	5,322.8	5,323.1	0.3
I	1,990	34	105	7.1	5,324.2	5,324.2	5,324.2	0.0
J	2,170	74	86	6.0	5,335.3	5,335.3	5,335.3	0.0
K	2,628	178	171	2.9	5,341.4	5,341.4	5,341.4	0.0
L	2,795	80	372	1.9	5,343.4	5,343.4	5,343.4	0.0
M	3,082	54	93	7.4	5,344.8	5,344.8	5,344.8	0.0
N	3,295	180	112	4.8	5,364.2	5,364.2	5,364.2	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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FIRST AVENUE TRIBUTARY

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sand Creek								
A	18,550	139/39[2]	1,565	19.2	5,213.8	5,213.8	5,213.8	0.0
B	18,660	237/110[2]	3,020	9.9	5,218.7	5,218.7	5,218.7	0.0
C	19,125	324	2,713	11.1	5,219.9	5,219.9	5,219.9	0.0
D	19,397	186	2,127	14.1	5,220.7	5,220.7	5,220.7	0.0
E	19,515	290	4,285	7.0	5,228.0	5,228.0	5,228.0	0.0
F	19,871	434	4,530	6.6	5,228.7	5,228.7	5,228.7	0.0
G	20,075	293	3,203	9.4	5,228.8	5,228.8	5,228.8	0.0
H	20,200	422	3,957	7.6	5,229.9	5,229.9	5,229.9	0.0
I	20,722	336	3,328	9.0	5,231.0	5,231.0	5,231.0	0.0
J	21,161	270	2,550	11.8	5,232.3	5,232.3	5,232.3	0.0
K	21,243	298	3,081	9.7	5,236.4	5,236.4	5,236.4	0.0
L	21,435	354	2,963	10.1	5,236.7	5,236.7	5,236.7	0.0
M	22,576	619	4,231	7.1	5,241.4	5,241.4	5,241.5	0.1
N	23,535	593	2,642	11.4	5,243.4	5,243.4	5,243.4	0.0
O	24,428	525	3,901	7.7	5,249.0	5,249.0	5,249.0	0.0
P	25,333	401	3,496	8.6	5,251.6	5,251.6	5,251.6	0.0
Q	26,395	399	3,545	8.5	5,254.5	5,254.5	5,254.6	0.1
R	26,502	298	3,110	9.6	5,256.0	5,256.0	5,256.0	0.0
S	26,575	332	3,050	9.8	5,256.5	5,256.5	5,256.5	0.0
T	26,658	364	4,321	6.9	5,260.0	5,260.0	5,260.0	0.0
U	28,403	182	1,937	15.5	5,264.9	5,264.9	5,264.9	0.0
V	28,600	165	2,964	10.1	5,271.3	5,271.3	5,271.3	0.0
W	28,870	205	3,366	8.9	5,272.1	5,272.1	5,272.1	0.0
X	30,762	494	5,285	5.5	5,274.2	5,274.2	5,274.2	0.0
Y	31,503	300	2,468	11.8	5,275.2	5,275.2	5,275.2	0.0
Z	32,573	285	2,388	12.2	5,281.2	5,281.2	5,281.3	0.1

[1]Feet Above Mouth [2]Width/Width Within Corporate Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

SAND CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sand Creek (Cont'd)								
AA	33,145	530	4,749	6.1	5,287.6	5,287.6	5,287.7	0.1
AB	33,983	632	5,401	5.4	5,289.0	5,289.0	5,289.1	0.1
AC	35,785	654	4,555	6.4	5,292.7	5,292.7	5,292.7	0.0
AD	36,270	486	3,351	8.7	5,294.5	5,294.5	5,294.7	0.2
AE	36,760	764/324[2]	4,492	6.5	5,296.6	5,296.6	5,296.7	0.1

[1]Feet Above Mouth [2]Width/Width Within Corporate Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

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SAND CREEK

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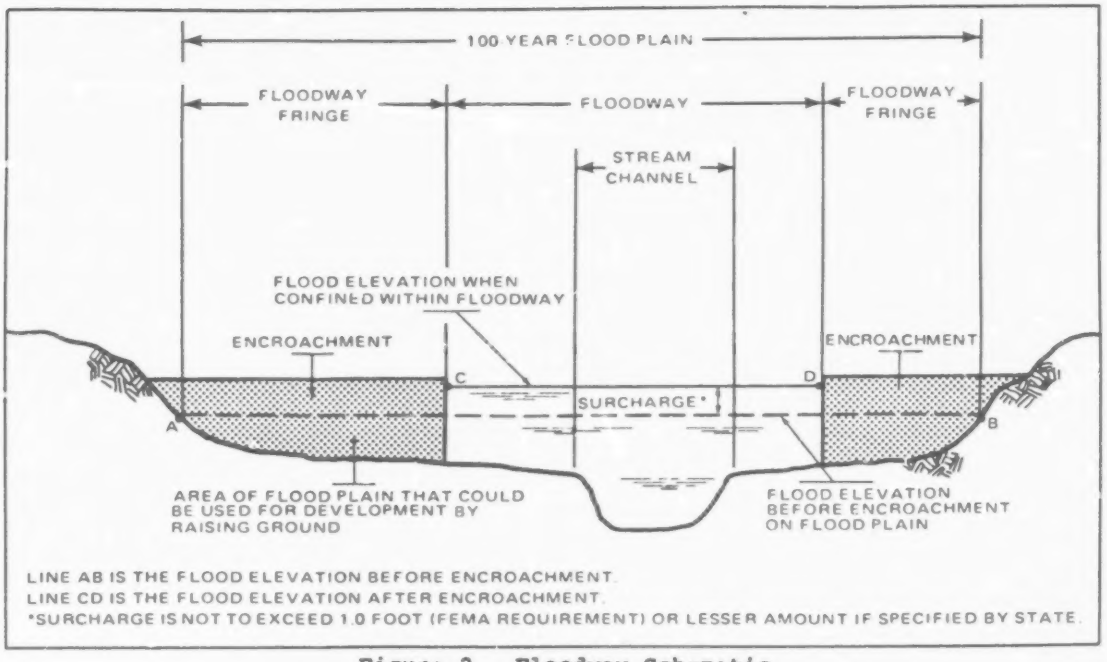
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City and County of Denver.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

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The locations of the reaches determined for the flooding sources affecting the City and County of Denver are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zones A1-A9, A11-A15, and A18:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Clear Creek							
Reach 1	0003	-6.4	-2.3	3.1	065	A13	Varies - See Map
Bear Creek							
Reach 1	0022	-2.9	-0.6	1.6	030	A6	Varies - See Map
Reach 2	0022	-1.3	-0.3	0.7	015	A3	Varies - See Map
Reach 3	0017,0021 0022	-2.5	-0.7	1.8	025	A5	Varies - See Map
Cherry Creek							
Reach 1	0010,0014	-4.4	-1.8	4.0	045	A9	Varies - See Map
Reach 2	0014,0015	-4.1	-2.2	2.0	040	A8	Varies - See Map
Reach 3	0015,0019 0020	-2.7	-1.0	2.3	025	A5	Varies - See Map
Reach 4	0020	-1.4	-0.5	1.3	015	A3	Varies - See Map
Reach 5	0020,0025	-0.8	-0.1	2.3	010	A2	Varies - See Map
Lakewood Gulch							
Reach 1	0009,0010 0013	-2.0	-0.8	1.7	020	A4	Varies - See Map
Lakewood Gulch Overflow							
Reach 1	0009,0010	-1.1	-0.2	1.0	010	A2	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOOD INSURANCE ZONE DATA

CLEAR CREEK-BEAR CREEK-CHERRY CREEK-LAKEWOOD GULCH-LAKEWOOD GULCH OVERFLOW

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Dry Gulch (Lakewood Gulch Tributary)							
Reach 1	0009	1.1	0.3	-0.7	010	A2	Varies - See Map
Reach 2	0009	1.9	0.6	-1.1	020	A4	Varies - See Map
Reach 3	0009	2.7	1.0	-1.5	025	A5	Varies - See Map
Harvard Gulch							
Reach 1	0018,0019	-1.0	-0.3	0.6	010	A2	Varies - See Map
Shallow Flooding	0018,0019	N/A	N/A	N/A	N/A	A0	Depths 1, 2
Harvard Gulch Overflow							
Reach 1	0018	-0.8	-0.3	0.4	010	A2	Varies - See Map
Shallow Flooding	0018	N/A	N/A	N/A	N/A	A0	Depth 1
Dry Gulch (Harvard Gulch Tributary)							
Reach 1	0018	-0.7	-0.2	0.5	005	A1	Varies - See Map
Shallow Flooding	0018	N/A	N/A	N/A	N/A	A0	Depth 2
West Harvard Gulch							
Reach 1	0017,0018	-0.8	-0.2	0.4	010	A2	Varies - See Map
Shallow Flooding	0018	N/A	N/A	N/A	N/A	A0	Depth 1
Goldsmith Gulch							
Reach 1	0019	-0.4	-0.1	0.2	005	A1	Varies - See Map
Reach 2	0019,0020 0024,0025	-0.8	-0.2	0.4	010	A2	Varies - See Map
Shallow Flooding	0019	N/A	N/A	N/A	N/A	A0	Depths 1, 2, 3

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

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FLOOD INSURANCE ZONE DATA

DRY GULCH (LAKEWOOD GULCH TRIBUTARY)-HARVARD GULCH-HARVARD GULCH OVERFLOW
DRY GULCH (HARVARD GULCH TRIBUTARY)-WEST HARVARD GULCH-GOLDSMITH GULCH

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Southmoor Park Tributary							
Reach 1	0024,0025	0.0	0.0	0.8	005	A1	Varies - See Map
Sanderson Gulch							
Reach 1	0018	-1.1	-0.3	0.5	010	A2	Varies - See Map
Reach 2	0018	-3.3	-1.8	1.6	035	A7	Varies - See Map
Reach 3	0018	-1.5	-0.5	0.9	015	A3	Varies - See Map
Reach 4	0018	-2.5	-0.4	0.7	025	A5	Varies - See Map
Reach 5	0017,0018	-1.4	-0.4	0.8	015	A3	Varies - See Map
Reach 6	0017	-2.9	-0.5	0.9	030	A6	Varies - See Map
Reach 7	0017	-1.3	-0.3	0.7	015	A3	Varies - See Map
Shallow Flooding	0014,0018	N/A	N/A	N/A	N/A	A0	Depths 1, 2, 3
Weir Gulch							
Reach 1	0010,0014	-2.6	-0.6	2.5	025	A5	Varies - See Map
Reach 2	0013	-1.4	-0.3	1.3	015	A3	Varies - See Map
Reach 3	0013	-9.1	-1.3	1.5	090	A18	Varies - See Map
Reach 4	0013	-6.4	-1.0	1.3	065	A13	Varies - See Map
Reach 5	0013	-3.7	-1.0	2.0	035	A7	Varies - See Map
Reach 6	0013	-2.2	-0.7	1.4	020	A4	Varies - See Map
Reach 7	0013	-1.4	-0.3	1.0	015	A3	Varies - See Map
Reach 8	0013	-0.9	-0.3	0.6	010	A2	Varies - See Map
Dakota Avenue Tributary							
Shallow Flooding	0013	N/A	N/A	N/A	N/A	A0	Depth 1

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

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TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOOD INSURANCE ZONE DATA

SOUTHMOOR PARK TRIBUTARY-SANDERSON GULCH-WEIR GULCH-DAKOTA AVENUE TRIBUTARY

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
First Avenue Tributary							
Reach 1	0013	0.4	0.1	-0.4	005	A1	Varies - See Map
Sand Creek							
Reach 1	0006	-6.2	-2.3	0.5	060	A12	Varies - See Map
Reach 2	0006	-7.3	-2.8	0.6	075	A15	Varies - See Map
Reach 3	0006	-4.4	-1.5	0.5	045	A9	Varies - See Map
Reach 4	0006	-5.6	-1.8	0.9	055	A11	Varies - See Map
Reach 5	0006,0012	-7.1	-2.2	1.2	070	A14	Varies - See Map
Reach 6	0006,0012	-4.1	-1.8	2.2	040	A8	Varies - See Map
Shallow Flooding	0006,0012	N/A	N/A	N/A	N/A	A0	Depth 3

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

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FLOOD INSURANCE ZONE DATA

FIRST AVENUE TRIBUTARY-SAND CREEK

depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flood hazard; not subdivided.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City and County of Denver is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Several flood plain studies have been conducted for streams throughout the Denver area. The results of these studies were reviewed and were incorporated where appropriate in this Flood Insurance Study.

The U.S. Army Corps of Engineers, Omaha District, prepared a Preliminary Flood Plain Information report for the South Platte River in 1980 (Reference 53). Hydraulic and hydrologic data from that report were used in this study.

A Flood Hazard Area Delineation report for Clear Creek was published in 1979 (Reference 22). That report contained hydrologic and hydraulic data for fully developed basin conditions; those data are in agreement with the analyses used in this study.

A Special Flood Hazard Information report for Bear Creek was published in 1972 (Reference 72). That report included a hydrologic analysis of Bear Creek using 1970 channel conditions and development. The report was completed before the construction of the Bear Creek Dam; therefore, discharges and flood elevations determined in the report do not reflect present-day flooding conditions.

The U.S. Army Corps of Engineers prepared a hydrologic analysis for Bear Creek downstream of Bear Creek Dam (Reference 24). Peak discharges were developed for different basin conditions. The discharge values developed using full basin development conditions are in agreement with the discharges used in this study.

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A Flood Hazard Area Delineation report for Bear Creek was published in 1979 (Reference 41). Hydrologic and hydraulic data for fully developed basin conditions, which were presented in that report, were utilized in this study.

A Flood Hazard Area Delineation report for Cherry Creek was published in 1976 (Reference 10). Data from that report were utilized wherever possible in this study; however, channel improvements completed in 1980 and 1981 necessitated recomputing the water-surface profiles in some areas.

The Urban Drainage and Flood Control District published several reports on Westerly Creek. The earliest report, published in 1976 (Reference 73), was superseded the next year by a Flood Hazard Area Delineation report (Reference 57) and a Major Drainageway Planning report (Reference 11). The 100-year boundaries shown in this study reflect some recent channel improvement and will therefore not agree with the previously published reports.

The Urban Drainage and Flood Control District published a 1978 Flood Hazard Area Delineation report which covered Coon Creek (Reference 59). The 100-year flood boundaries for Coon Creek presented in that report were used in this study.

The Urban Drainage and Flood Control District published two reports on Lakewood Gulch. The hydrologic analysis presented in the 1976 Major Drainageway Planning preliminary report (Reference 34) was used in the 1979 Flood Hazard Area Delineation report (Reference 46). The hydrologic and hydraulic data presented in those reports were utilized in this study.

The Urban Drainage and Flood Control District published Flood Hazard Area Delineation reports for Dry Gulch (Reference 12) and for Harvard Gulch, West Harvard Gulch, and Dry Gulch (Reference 14). The hydrologic and hydraulic data presented in those reports were utilized in this study.

The Urban Drainage and Flood Control District published a Flood Hazard Area Delineation report for Goldsmith Gulch and its tributaries in 1976 (Reference 15). Hydrologic and hydraulic data in that report for Goldsmith Gulch and Southmoor Park Tributary were used in this study. However, 100- and 500-year boundaries in some portions of Goldsmith Gulch and Southmoor Park Tributary have been revised in this study to reflect recent channel improvements.

The Urban Drainage and Flood Control District published a 1979 Flood Hazard Area Delineation report for Sanderson Gulch (Reference 17). Hydrologic and hydraulic data from that report were utilized in this study.

The Urban Drainage and Flood Control District published a 1972 Major Drainageway Planning report for Sanderson and Weir Gulches (Reference 36). Hydrologic data from that report were used in this study for Sanderson Gulch and Weir Gulch. Flood boundaries and water-supply profiles presented

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in this study reflect recent channel improvements and, therefore, will not agree with the previously published report. Peak discharge data for Weir Gulch downstream of Barnum Lake were revised in this study due to channel improvements and the construction of an additional culvert under West 6th Avenue (U.S. Highway 6).

The Urban Drainage and Flood Control District published a Flood Hazard Area Delineation report for the Weir Gulch tributaries in 1977 (Reference 20). Hydrologic and hydraulic information for First Avenue Tributary and Dakota Avenue Tributary was included for use in this study. Due to a review of the hydrualic data and normal-depth calculations, flooding along Dakota Avenue Tributary has been identified as shallow flooding with average depths of 1.0 foot in this study.

The Urban Drainage and Flood Control District published a Flood Hazard Area Delineation report for Sand Creek (Reference 37). Hydrologic and hydraulic data from that report were used in the analysis of Sand Creek for this study.

In 1977, the Urban Drainage and Flood Control District published a Major Drainageway Planning report for First Creek and First Creek Tributary (Reference 60). The hydrologic and hydraulic analyses in that report were based on fully developed basin conditions. The 100-year flood boundaries presented in the report have been used in this study, but have been designated as approximate because basin conditions have not reached full development.

The Urban Drainage and Flood Control District published Flood Hazard Delineation reports for Sloans Lake Basin (Reference 61) and Marston Lake North Drainage Basin (Reference 62). The 100-year drainage basin boundaries presented in these reports were used in this study as approximate studies for Sloans Lake Basin and Marston Lake North Drainage Basin.

A Flood Hazard Boundary Map has been published for the City and County of Denver (Reference 71). Flood boundaries determined for this study supersede the Flood Hazard Boundary Map.

A revised Flood Insurance Rate Map has been prepared for the City of Aurora (Reference 74). Flooding on Westerly Creek was studied by detailed methods in Aurora, whereas the Denver study presents it as an approximate analysis. In all other areas, the two studies are in agreement.

A Flood Insurance Study has been prepared for the City of Commerce City (Reference 75). The South Platte River was studied by detailed methods within Commerce City, whereas this study presents the river as an approximate analysis pending hydrologic and hydraulic reanalysis, which is to be incorporated into the Denver study at a later date. The South Platte River 100-year flood boundaries are in agreement between the two studies. Zone B shallow flooding originating from the right bank of Sand Creek upstream of Commerce City was determined in the Denver Flood Insurance Study to flow north and northwest along the overbanks. The flows were

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only analyzed in the Denver study as far as Quebec Street which forms the corporate limits between Denver and Commerce City. This shallow flooding was not analyzed as part of the Commerce City Flood Insurance Study. In all other areas, the two studies are in agreement.

A Flood Insurance Rate Map (FIRM) has been prepared for the City of Wheat Ridge (Reference 76). There is a discrepancy between the 100-year zone designation determined for Clear Creek for this study and the zone designation shown on the Wheat Ridge FIRM. This difference is due to the different reach length used to determine the zone designation in each study. In all other areas, the two studies are in agreement.

A Flood Insurance Study has been published for Adams County (Reference 77). That study is in agreement with this study, with the exception of flooding along First Creek, First Creek Tributary, and the South Platte River. The 100-year flood boundaries along First Creek disagree between the two studies; it has been determined that the Denver study more accurately presents the flooding and that the Adams County study will be revised at some future time to match it. Flooding on First Creek Tributary was analyzed by approximate methods in the Denver study, but was not analyzed in the Adams County study. Flooding on South Platte River was studied by detailed analysis in the Adams County study, whereas this study presents it as an approximate analysis due to impending hydrologic and hydraulic reanalyses.

A Flood Insurance Study has been prepared for the City of Cherry Hills Village (Reference 78). Blackmer Gulch was studied by detailed methods within Cherry Hills Village upstream to Whitehall Drive, which forms the corporate limits between Cherry Hills Village and Denver. Blackmer Gulch was not studied as part of the Denver Flood Insurance Study. In all other areas, the two studies are in agreement.

A Flood Insurance Rate Map has been prepared for the City of Englewood (Reference 79). West Harvard Gulch, studied by detailed methods in the Denver Flood Insurance Study, was not studied as part of the Englewood study. In all other areas, the two studies are in agreement.

A Flood Insurance Study has been prepared for the City of Sheridan (Reference 80). The Sheridan study was completed before the construction of the Bear Creek Dam located just downstream of the Town of Morrison in Jefferson County. Hydrologic and hydraulic analyses of Bear Creek for the Denver Flood Insurance Study consider the construction of the dam and are more representative of present-day flooding conditions.

A revised FIRM has been published for the City of Lakewood (Reference 81). That FIRM is in agreement with this study with the following exceptions:

(1) Flooding from Lakewood Gulch in Lakewood does not agree with the detailed analyses of Lakewood Gulch within Denver. Lakewood Gulch flooding determined for this study is a more recent analysis and, therefore, supersedes the Lakewood FIRM.

(2) Flood boundaries for 500-year flooding were not determined for Weir Gulch, Dakota Avenue Tributary, First Avenue Tributary, Dry Gulch (Lakewood Gulch Tributary), and Sanderson Gulch within Lakewood due to the limited scope of study.

(3) Dakota Avenue Tributary flooding has been identified as shallow flooding downstream of Sheridan Boulevard (State Highway 95) in this study.

(4) On Weir Gulch and First Avenue Tributary, 100-year elevations and flood boundaries are in disagreement with those determined for this study. This study is a more recent analysis and, therefore, supersedes the Lakewood FIRM.

(5) Bear Creek is presented as an approximate study within Lakewood and as a detailed study within Denver.

A Flood Insurance Study has been published for the City of Littleton (Reference 82). FIRMs have been published for the City of Greenwood Village and for the unincorporated areas of Arapahoe County (References 83 and 84, respectively). A Flood Hazard Boundary Map has been prepared for the City of Edgewater (Reference 85). These adjacent studies are in general agreement with this study.

A Flood Hazard Boundary Map has been published for the unincorporated areas of Jefferson County (Reference 86). Flooding determined for this study represents more recent analysis and, therefore supersedes the Jefferson County Flood Hazard Boundary Map.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

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